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A SUMMARY OF CURRENT RESEARCHES RELATING TO
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JOURNAL
OF THE
ROYAL MICROSCOPICAL SOCIETY.

MARCH, 1932.

TRANSACTIONS OF THE SOCIETY.

PRESIDENTIAL ADDRESS.

I.—NUCLEAR STRUCTURE.

575. 22.

By PROF. R. RUGGLES GATES, LL.D., F.R.S.

(Delivered January 20th, 1932.)

At the time of our last annual meeting the Society had recently moved into B.M.A. House. During the past year we have become familiar with the advantages of our new quarters, both as regards the location and the facilities afforded by its splendid halls for our meetings and for housing appropriately the Library and collections of the Society. Notwithstanding the economic difficulties of the time, our numbers have been well maintained and interest in the meetings has continued unabated. The Journal has increased its value as a medium of scientific publication on microscopical subjects, and the extensive system of abstracting biological papers is a feature which continues to be useful to workers in many fields.

Of those who have been lost from our ranks during the past year I should like to say a word concerning Lady Bruce and Lady Crisp. Lady Bruce, who was elected an Honorary Fellow of the Society in 1918, died on November 23rd, 1931, only four days before her distinguished husband. Sir David Bruce's investigation of Malta fever was a triumph of preventive medicine. His discovery and investigations of the life histories of trypanosomes and their transmission to animals and man by the tsetse fly rank high in the history of tropical medicine. These investigations took him into the wildest parts of Africa, and I am justified in referring to them in this connection because in all this work Lady Bruce was his constant companion and

helper. She was a skilled microscopist with knowledge of laboratory technique, and thus played an essential rôle in his discoveries.

Lady Crisp, who was elected a Life Member in 1884, outlived her husband by many years. Sir Frank Crisp served the Society both as Secretary and as Editor of the Journal, and was also its generous benefactor, as many Fellows have reason to know.

Fuller statements concerning the work of the Society are contained in the Reports of the Council and Treasurer, so I propose now to turn to the subject of my address.

Just a century ago—in 1881—Robert Brown recognized the importance of the nucleus as a body present in every living cell. The cell theory of organic structure was put forward a few years afterwards, when conceptions regarding the origin of cells and the relation between the cell and its nucleus were still very confused and uncertain. Not until the decade beginning in 1875, when the general features of karyokinetic cell division in plants and animals were worked out by Flemming, Oscar Hertwig, Strasburger, and others, was it possible to recognize not only that cells were always derived by division from a previous cell, but that the nucleus played the most fundamental part in that process.

The last half-century has witnessed great and continuous advances in our knowledge of the structure of the nucleus, particularly in its relation to hereditary and developmental processes. To a considerably less extent has come enlightenment concerning the physiology of the nucleus, and the means by which it exercises its control over the activities of the cell. Its dominating importance in all these aspects of vital activity no biologist disputes. We may freely recognize that if cells were without this centre—the nucleus—exercising its physiological control and containing relatively stable elements in a partially fixed spatial arrangement, the phenomena of development, inheritance, and evolution could not have taken place. The panorama of life in past ages, with frequently increasing complexity added to complexity, as the biologist sees it unfolded, could not have been attained except through a succession of nuclei derived by a complicated process of division, in which the most conservative elements of the cell were all divided with meticulous care in each cell generation. From this point of view the split of the chromosomes and chromomeres in mitosis is an hereditary process, maintaining and perpetuating the relatively stable chemical and structural elements which make the phenomena of heredity possible. The fundamental features of organisms such as growth, differentiation, and reproduction, which distinguish them from inorganic bodies, depend ultimately upon the continuing relations between the cytoplasm and its contained nucleus—a relationship quite different from and on a much higher level of complexity than the physicists' conception of the balance between electrons and protons in the atom.

Modern work on the nucleus indicates that the only structural elements persisting from mitosis to mitosis are the chromosomes. Except where the

spindle is entirely intranuclear (as in many of the Protista), the karyolymph is liberated into the cytoplasm during mitosis, and probably by this means influences the development of the cell, as Conklin (1929) has emphasized. I will not enter into the chemical aspects of the chromosomes here, except to mention that they are generally regarded as composed of two substances, (1) basichromatin or nucleic acid, which waxes and wanes during the mitotic cycle, (2) the oxyphilic component or linin, which most cytologists now agree forms the framework and structural basis of the chromosome. This view has been held by many cytologists since first adopted by Haecker and Strasburger. Nevertheless, we know very little regarding the chemical relations and the structural differences between these two substances, and the Grégoire school denies that two distinct substances exist. Recent evidence, however, favours the view that two substances are present both in chromosomes and nucleolus, although usage has been very inconsistent in the names applied to them.

The nucleolus is generally described as a body appearing *de novo* in the telophase of mitosis and disappearing when the nuclear membrane breaks down in the succeeding metaphase. The extensive literature on the nucleolus has been summarized as regards modern work by Ludford (1922) for animal cells and by Sharp (1926) for plants. Wilson's (1925) classification of nucleoli uses the old terms "plasmosome" and "karyosome," and is generally followed by animal cytologists, but until very recently there has been no clear evidence of two types of nucleoli in the cells of higher plants. Here it need only be pointed out that Wager, as early as 1904, found a regular connection between the nucleolus and the spireme in root-tips of the bean, and suggested that the nucleolus contributed material to the formation of the chromosomes. Various authors have found a similar relationship. Many early accounts in animal cytology described the chromosomes as arising in part from the nucleolus, but for the most part without subsequent confirmation. More recently in my own laboratory a definite connection between the spireme and a body in the nucleolus has been found in the pollen mother-cells of *Lathyrus* (Latter, 1926), *Lathræa* (Gates and Latter, 1927), and *Malva* (Latter, 1932). Yeates (1925) finds, in a study of the nucleoli in the Pteridophyte *Tmesipteris*, that in prophase the nucleoli are connected with the spireme, not becoming detached from the chromosomes until metaphase, when they are distributed towards the poles at random.

Fikry (1930) has pointed out the difficulties which have to be met in explaining the actual passage of material from nucleolus to chromosomes, not the least of which is that in many forms at least there is no continuous spireme stage in prophase. Zirkle (1928) has, however, obtained interesting evidence of another kind. On the root-tips of maize he used various fixatives, some of which fixed nucleoli, basichromatin, and mitochondria, while others dissolved one or more of them. He found the nucleolus connected with the "spireme" in prophase, and that it later elongates into a rod which constricts into a dumb-bell, and then pulls apart into two portions, which pass

to the poles of the spindle and are soon lost in the cytoplasm.* From this and other evidence Zirkle concludes that the nucleolar material is partly passed to the chromosomes in prophase and partly remains as a distinct body which fragments in the cytoplasm. Others have previously found that the nucleoli arise in telophase from material extruded by the chromosomes. Thus part of the nucleolar material of each cell generation could enter into the structure of the chromosomes, and part would be lost in the cytoplasm. Zirkle calls the nucleolar material plastin, and finds no basichromatin present, yet he obtains other evidence for the presence of two substances, if not more, in the nucleolus. These results are inconclusive in many respects, but they have been strengthened by another paper (Zirkle, 1931) making a similar study of the root-tips and cambium of *Pinus*. Again, he finds the "plastin" passing from nucleolus to spireme in prophase and back into a nucleolus in telophase, while the "other substance" is not chromatin.

It may be pointed out that evidence has been obtained in my laboratory (Selim, 1930) and recently confirmed, that in certain varieties of cultivated rice having a large nucleolus in the pollen mother-cells the nucleolus divides during synapsis into two, which remain attached to each other and show a constant difference in staining properties, one disappearing earlier than the other. We may, then, conclude tentatively that at any rate in plant cells the nucleolus generally contains two substances which may occasionally form separate bodies, and that one of these substances enters into the prophase transformations of the chromosomes while the other does not. In animal cells, where the nucleolar conditions are more varied, the amphinucleoli frequently described in invertebrate egg nuclei may perhaps correspond with the condition above mentioned in rice. Further work of a cytological and biochemical character is needed to elucidate the relationships between nucleolus and chromosomes, but there is nothing detrimental to the stability of the germinal material in the conception that one fluid constituent of the nucleolus impregnates the chromosomes in prophase and is given up again in telophase to form a separate droplet of material, though the advantage derived from such a chemical mechanism is by no means clear.

I wish next to suggest that although the nucleolus may, in each mitosis, pour some of its material into the growing chromosomes, yet the nucleus is essentially a compound structure, composed of the chromosome axes as its structural units. The evidence for this, so far as I am aware, is chiefly confined to animal cells. The condition known as karyomeres, in which the chromosomes in telophase form a group of vesicles, each from a separate chromosome, instead of coalescing to form a single nucleus, is known in various phyla of the animal kingdom.

Among recent observations of this kind, one of the most striking is that of Richards (1917) on the chromosome vesicles or karyomeres in the cleavage of the eggs of the teleost *Fundulus*. Although these vesicles become closely appressed in the "resting" condition of the chromosomes, yet the delicate

* Frew and Bowen (1929) have described the same thing in *Cucurbita*.

vesicle walls persist between them, and the vesicles do not completely coalesce until after each has formed a chromosome within itself in the prophase.

Similarly in the gasteropod *Haminea* (Smallwood, 1904), in the maturation mitoses of the egg the chromosomes remain as vesicles even on the heterotypic spindle. Then a chromosome develops in each vesicle. When the polar bodies are formed the egg nucleus is represented by a group of chromosome vesicles, while the male nucleus from the sperm approaches. In the cleavage mitoses these vesicles are incompletely fused. The same author (Smallwood, 1905) has described a less marked occurrence of vesicles, each like a miniature nucleus, in *Nudibranchs*. They were observed in the resting pause between the two maturation divisions of the egg. Chromosome vesicles are a conspicuous feature of cleavage in the tardigrade *Macrobiotus* (Wenck, 1914). One of the most extreme cases on record was described by Reuter (1909) in the tiny insect *Pediculopsis*. The egg in cleavage has four chromosomes, each of which is contained in a vesicle. The chromosome in each vesicle splits, and its halves pass to opposite ends of the vesicle, which has elongated in the meantime. In metaphase the vesicles persist and become arranged in the median plane. They are finally constricted across the middle, and so carry one chromosome (in its vesicle) to each end of the spindle, but in some mitoses two or more of the karyomeres are fused.

In many grasshoppers the X-chromosome is known always to form a separate vesicle from the rest of the nucleus, and in many other insects the X-chromosome shows its independence by becoming compact in the prophase while the other chromosomes are still in the diffuse state. In the grasshopper *Phrynotettix*, Wenrich (1916) has shown that in telophase of the spermatogonial divisions the nucleus is divided into compartments, each containing a single chromosome. In the following prophase the separating membranes have partially disappeared, but the X-chromosome remains completely enclosed in a vesicle of its own.*

The frequent formation of chromosome vesicles in animal nuclei and their apparent lack in plants may possibly be a reflection of the greater chemical differentiation of chromosomes in animal than in plant cells. However that may be, the evidence cited, together with the far wider evidence that, with rare exceptions, each chromosome throughout the plant and animal kingdoms maintains its morphological peculiarities from one cell generation to another, confirms the view that the resting nucleus contains the chromo-

* A closely related phenomenon now known in a number of animals is that in which the two germ nuclei maintain their separate identity in the cleavage of the egg. Observed by Haecker in *Cyclops* as early as 1892 [since studied more fully by Heberer (1925, 1927)], this condition was carefully studied by Conklin (1901) in *Crepidula*. He showed that up to the 29-cell stage the double character of the nucleus could be seen in the telophase of every cleavage, while it was frequently observed and probably always occurred in all the later cleavages. The two nuclei were in contact, separated only by a groove, each with a single nucleolus, but maintaining their spatial relationship to each other so that the maternal and paternal components could be recognized. In the amphibian *Cryptobranchus* (Smith, 1919) the separate existence of the pronuclei during cleavage is even more conspicuous, and various other cases have been described. The condition of conjugate divisions of paired nuclei, which is so characteristic a feature of the Fungi, is only a step further in the same direction, but in this case of course there are two separate spindles.

some materials in the same spatial arrangement as the chromosomes happened to occupy in the preceding telophase.

But I wish to go a stage further, and suggest that the nucleus is a compound structure in a still more fundamental sense. My view is that the spindle is also compound, and that the real unit in mitosis is the chromosome with its attached spindle fibres, whatever they may be. There is admittedly not much observational evidence for such a view at the present time, but much recent work has shown that a constriction of the chromosome always occurs at the point where the force which leads to the translational movement of the chromosome is applied. My view also implies the intranuclear origin of the central spindle through transformation of the karyolymph, apparently accompanied by the setting up of strains in its substance. Perhaps the best evidence for my view is contained in a paper by Hughes-Schrader (1924) on oogenesis in *Acroschismus*, an insect of the order Strepsiptera, which parasitizes the larvæ of certain wasps. The haploid number of chromosomes is eight, and in the egg after maturation they form a group of eight vesicles instead of a single nucleus. Before maturation, chromosome vesicles are more or less recognizable in the egg nucleus, although a complete surrounding membrane is present. Around each bivalent chromosome appears a "nebulous sheath," which becomes drawn out into a fusiform shape. These sheaths are at first oriented in all directions within the nucleus, but gradually become arranged parallel to each other and so form the spindle, which is thus a compound structure. For further evidence see Hughes-Schrader (1931).

The well-known multipolar spindle of spore mother-cells was long regarded as cytoplasmic in origin, but since the work of Devisé (1921) on the larch, and of others which cannot be referred to here, it has been recognized that this structure is at least partly nuclear in origin. Its multipolar character may be an indication of its compound nature, although there is no indication that the number of poles corresponds with the number of chromosomes. In further study of the difficult dynamical problems of mitosis, I believe it is important to recognize that the spindle fibre is not a mysterious something which grows in and becomes attached to the chromosome, but rather that a portion of the karyolymph surrounding each chromosome becomes anisotropic, elongates, and ultimately serves as the avenue along which the two halves of the chromosome diverge in their movement towards the poles.

If the views expressed above have some validity, then the configurations of the mitotic figure derive their unity from the fact that the various chromosomes go through their evolutions simultaneously but independently. Let us now consider briefly the structure and history of the chromosome itself. Roux, in 1883, was the first to recognize the fundamental significance of the fact that chromosomes universally undergo longitudinal division, an act of reproduction which we have already suggested makes possible the phenomena of heredity. I need not emphasize the great mass of modern observations on chromosomes, which show that the most minute details of their structure,

including their relative lengths, the presence or absence of satellites,* "knobs" or "heads," and the fixed position of the spindle fibre attachment or other constrictions, is constant from cell to cell, so that in many species of plants and animals one or more, or in some cases all the chromosomes, can be distinguished from each other by their morphology. In many cases, however, no visible differences between the chromosomes of a metaphase group have been observed. This appears to represent a primitive condition, from which organisms with visibly unlike chromosomes have been derived. How this evolutionary differentiation of chromosomes has taken place in higher organisms is a large subject, which I do not propose to discuss on this occasion. One may only mention that two methods of chromosome differentiation for which there is strong evidence are, (1) by transverse fragmentation of single chromosomes, and (2) by end-to-end fusion of two to form one. The former has probably occurred in such Liliaceous genera as *Yucca*, *Albuca*, and *Galtonia*, in which certain long chromosomes of related genera are represented by several short ones; while the latter has evidently taken place in the evolution of the genus *Drosophila*.

Terminal attachment of the spindle fibre is also probably a primitive condition, from which a sub-terminal or median attachment has been derived. It has recently been suggested (Helwig, 1929), from a study of the grasshopper *Circotettix verruculatus*, that this shifting has taken place through inversion of a section of the chromosome. Such inversions have been shown genetically to have taken place in *Drosophila* and other genera, and they have also occurred after treatment with X-rays. Helwig finds that in the above species three pairs of chromosomes are regularly telomitic (with terminal attachment to spindle fibre), four are constantly atelomitic, while in the remaining three pairs the attachments vary from one individual to another. But each individual is constant as regards the locus of fibre attachment, and consequently as regards the form of the chromosomes. The position of fibre attachment of each chromosome is independently inherited in the Mendelian manner, and it is found that populations from different parts of the distribution of the species differ in the frequency with which two of the chromosomes are atelomitic. Since these differences in homologous chromosomes affect crossing-over, this, combined with isolation, would furnish a basis for the origin of geographic races. Heteromorphic pairs of chromosomes, of the kind mentioned above, have been described in several other animals and plants.

Polyploidy is another type of chromosome change which is known from the work of the last twenty years to be of great phylogenetic importance in plants, although of little significance in animals. Some years ago, when I summarized our knowledge of the subject (Gates, 1924), it was already clear that in many genera of plants the chromosome numbers ran in multiples from species to species, and since then it has transpired that, among flowering plants, polyploid genera are much more numerous than those in which the

* S. Navashin (1912) discovered these bodies, which have been investigated by Taylor (1925, and other papers), M. Navashin (1929, 1930), and others.

number of chromosomes remains constant or varies in some other way. The whole subject of polyploidy has now become so large that a volume would be required to deal with it. I will only say that it confirms the view of the chromosome as the structural unit within the nucleus.

One aspect of the subject will, however, be mentioned further, because it is relatively unknown. Certain somatic tissues regularly become polyploid while the germ cells remain diploid. During metamorphosis in the mosquito, *Culex pipiens*, the nuclei of the intestinal epithelium regularly become highly polyploid (Holt, 1917), the chromosome number rising from three pairs (the diploid number) to as many as 48 or even 72, but without increase in cell size. In a paper by Frolowa (1926), in which she studied the chromosome numbers in eight Russian species of *Drosophila*, fixed polyploid conditions were found in certain tissues. Thus in all species examined the tracheal cells of the larvæ were found to be tetraploid, and the rectal gland cells, which are very large, octoploid, while observations indicated that other somatic tissues remained diploid. Similar observations were made on the larvæ of *Calliphora erythrocephala*. It is thus possible that polyploidy of certain tissues will be found as an ontogenetic phenomenon not only in insects, but also in higher animals with even greater differentiation of tissues.*

In plants, it is well known that tetraploid cells occur sporadically in the diploid tissues of root and stem, or an entire tetraploid root may occur in a diploid plant (M. Navashin, 1930), while in haploids (see Gates and Goodwin, 1930) occasional cells of the stem or a whole sector of the root may become diploid. Of much interest is also the finding of Winge (1927), that when sugar beets are infected with crown gall (*Bacterium tumefaciens*), the resulting hypertrophied tissues are tetraploid, having 36 chromosomes instead of 18, and that the tetraploid condition persists even in new tumours formed by transplantation. Very often the cells become octoploid, and occasionally even higher chromosome numbers are seen, while reversions to small-celled diploid tissue sometimes occur. Stein (1932) finds polyploidy phytocarcinoma induced by radium. (Winge, 1930) on carcinoma in mice, where the normal chromosome number is 40, a two-peaked curve is obtained for chromosome numbers in the cancer tissue, with maxima at about 38 and 68. This is similar to the earlier results of Farmer, Moore, and Walker (1906) who, from the study of various human cancers, obtained graphs with maxima at about 16, 32, 48, and 64. Again, Heiberg and Kemp (1929) have recently found in a carcinoma that the epithelial cells are mostly diploid, while the other cells generally show mitotic irregularities. Many cells are tetraploid and some have higher numbers, while a few were haploid.

Let us now examine for a few minutes the intricate problems relating to the internal structure of the chromosomes, and with it the closely allied question of the exact method by which they divide. In this connection I

* Münzer (1925) has shown that some 9 p.c. of the liver cells of the rabbit are normally binucleate, and that the number can be experimentally increased to 22 p.c. He thinks the division of the liver cell nucleus is amitotic, but more evidence on the subject is required.

need only refer to recent work of Kaufman (1926 *a, b*), Sharp (1929), Telezynsky (1930), and to investigations recently completed in my laboratory by Hedayetullah (1932) and Perry (1932). From a study chiefly of somatic chromosomes in *Tradescantia* and *Podophyllum*, Kaufman concludes that the chromosomes contain a double spiral (chromonema) in early prophase, each of which splits in late prophase for the mitosis to follow. In anaphase and telophase the two spirals therefore still appear in each chromosome, and the chromosomes reappear as double structures in the following prophase. Essentially similar results were obtained by Sharp from a study of *Vicia* and several Monocotyledons. Telezynsky reaches similar conclusions from important observations on *living* nuclei.

By a careful study of mitosis in the root-tips of *Narcissus*, Hedayetullah has confirmed and extended these observations, and Miss Perry has reached similar results with the snowdrop (*Galanthus*). These investigations have cleared up a number of difficulties, so that we now have a consistent picture of the chromosome splitting in one metaphase for the separation which is to take place in the next. From these observations it appears clear that the chromonema undergoes a straight longitudinal split at or just before metaphase, while the paler staining matrix of the chromosome remains unchanged. In anaphase the two chromonemata in each chromosome begin to coil, and in telophase are generally twisted around each other. The chromosome is finally represented in the resting nucleus by two rows of chromomeres connected by threads. These are derived from the two chromonemata, the matrix of the chromosome having disappeared. In prophase, the chromomere stage is followed by their coalescence to form the two chromonemata representing each split chromosome. As already mentioned, these undergo longitudinal fission at the end of the prophase, and so complete the chromosome cycle.

This much seems clear and consistent. The chromomere and chromonema hypotheses are both found to be based on fact. The chromomere condition may be regarded as characteristic of the near-resting nucleus and the earlier stages of the prophase, until, by coalescence of the chromomeres, a continuous chromonema is produced. The chromonema or string of coalesced chromomeres (and probably also the thread connecting them) is then the only part of the chromosome which persists as a structural entity from one division to another.

Since the importance of the chromomere as a structural unit has been recognized, there has been a tendency to overlook the fact that the chromosome is itself a unit of a higher order, for whose existence as a fixed morphological entity we have no real explanation. If the chromosome is simply a chain of chromomeres, why do not the various chains coalesce with other chains at their ends or break at any point, thus giving rise to a chromosome group varying in morphology from cell to cell? Something of this kind has occasionally been described, e.g., in *Oenothera*, by Hance (1918), but his interpretation was inaccurate, and there is no good evidence that such variable segmentation ever takes place as a regular phenomenon in higher plants or

animals ; although it is true that the chromosomes of reptiles and birds, with their widely differing lengths, superficially give such an appearance. Formerly, a continuous spireme was supposed to be formed in the prophase of every somatic mitosis, but no recent critical account has shown such a structure, and the evidence is that each chromosome maintains its identity throughout the whole mitotic cycle. It may be that the delicate thread connecting the chromomeres, which is often near and probably sometimes below the limit of visibility, cannot be formed *de novo* between the end chromomeres of two different chromosomes. This would serve to emphasize the importance of the thread as an axis to the chromosome, and at the same time to account for the observed fixity of the chromosomes in relative length and in number in any tissue. That the thread connecting the chromosomes may have characteristics of its own and may differ from the intrachromosomal axis, is shown by several observations. It was found by Sheffield (1927) that the connections between linked chromosomes are much longer in the pollen mother-cells of *Oenothera lamarckiana* than in those of other *Oenothera* species. Again, in the somatic cells of *Euphorbia terracina* the chromosomes are generally joined in pairs by a terminal connection which is often very long (H. H. Harrison, 1930), and in the occasional tetraploid cells they are similarly linked in groups of four.

That, as a rare event having phylogenetic significance, two chromosomes may fuse permanently end-to-end, forming a single body, was shown in *Drosophila* by L. V. Morgan (1922), who bred a race in which the two X-chromosomes of the female were united in this way, with reversal of the ordinary criss-cross sex-linked inheritance. Not until the fourth generation did a single exception occur, in which the two X-chromosomes were broken apart. It was afterwards shown (L. V. Morgan, 1925) by linkage experiments that the two chromosomes were joined by their "right" ends, and that crossing-over could still take place between the attached chromosomes. Sturtevant (1931) described two new attached -X lines of *Drosophila*, each derived from an XX sperm. Other instances in which this form of chromosome fusion has apparently occurred are cited by Gates and Rees (1921). Pchakadze (1930) has found certain cases in Trichoptera. Thus in *Stenophylax infumatus* $n=30$, while in the nearly related *S. stellatus* $n=29$, but one chromosome is exceptionally large and is believed to be formed by the end-to-end fusion of two.

We come now to the chromomere, which (if we except the axial thread) is the smallest visible unit in the chromosome. Chromomeres have been much studied in recent years by both animal and plant cytologists. Wenrich (1916) appears to have shown that in *Phrynotettix* each chromosome has a particular disposition of chromomeres of different sizes at fixed points along its axis. Many others have noted that in paired chromatin threads the chromomeres are usually also in pairs of corresponding size. Recent genetical theory has naturally led to a comparison of the chromomeres with the hypothetical genes. Bridges speaks of them as the houses in which the genes

live, and Belling (1928) has endeavoured to estimate their number in the pollen mother-cell nuclei of *Lilium* and *Aloe*. He finds over 2000 (2500 as upper limit) in *L. pardalinum* and about 1400 in *Aloe striata*. In further work, using smear preparations stained with iron-brazilin, Belling (1931) has extended his observations to several other liliaceous genera. He regards some of the chromomeres as compound, and by destaining found a small sub-microscopic dot in the centre of each chromomere. The subject of chromioles or genels and their possible relation to some forms of variegation and somatic segregation will not be considered here.

Estimating the number of genes in *Drosophila* to be at least 2000 (ten times this number is now considered more probable), Morgan (1922) used three methods for calculating the size of a gene. They were recognized to be subject to many sources of error, but they gave values of 20-70 μ for the diameter of the gene. It is interesting to compare with these values the sizes recently found by Barnard and Elford (1931) for the virus of ectromelia in mice. Using both the microscopical method with ultra-violet light and the method of filtration through collodion membranes, they found that the methods agreed in giving a value of about 150 μ for the diameter of the particles. The virus of foot-and-mouth disease was similarly calculated at 25-30 μ . It would, then, appear probable that virus particles and genes are of the same order of size, each containing probably not more than a few hundred organic molecules. It seems likely that particles of this size are the smallest in which vital phenomena can be exhibited, and, on the other hand, it is reasonable to suppose in the present state of knowledge that both viruses and genes are particles displaying the essential vital phenomena of growth and fission. In such a simple aggregate of organic molecules it is doubtful whether phenomena strictly resembling the assimilation in cellular organisms could take place. One may also raise the question whether respiration would necessarily occur in them, and whether they could be regarded as living if it did not. The border-line between living and non-living thus becomes largely a question of definition.

The relation between chromomeres and genes is a fundamental question now much discussed. It was pointed out years ago (Gates, 1915) that a factor or gene inherited in Mendelian fashion represents a difference which has arisen through a mutation in an element of the germplasm. The fact that innumerable gene mutations in plants and animals recur with calculable frequency, are inherited as fixed units, and can be produced with much higher frequency by treatment with X-rays, radium, and other agencies, justifies the hypothesis that in each gene mutation a definite structural element of the germinal material has undergone a sudden change. The investigation of crossing-over, developed on an enormous scale in *Drosophila* but known to occur in many other organisms, furnishes evidence of the strongest character in support of this conception, for it shows that the genes cross over in blocks together, which can only be accounted for by their axial arrangement at fixed positions in the chromosome.

In this connection it is of interest to point out that de Vries, in 1903, clearly visualized the "individual units" (genes) as arranged in the chromosomes in corresponding pairs when the chromosomes mate before their separation in meiosis. He also assumed that the members of each pair of units could exchange places, but assumed that this was a matter of chance. The chiasmatype theory of Janssens led to the present conception of crossing-over in blocks. On the genetical side, the theory that the percentage of crossing-over between two genes is a function of their distance apart in the chromosomes began with Morgan (1911).

E. S. Russell (1930), in his recent book, attacks the conception of the unit character, i.e., that each gene represents a single external character. This idea passed out of the minds of geneticists a decade ago. Bridges' conception of genic balance, based on the comparison of triploid *Drosophila*s with those having an extra sex chromosome, implied a definite abandonment of the unit character. It was thus the last in the long line of representative-particle conceptions, which began with the pangens of Darwin, and having played various useful parts in the history of biology, has now become extinct. In his attack on the theory of the gene, Russell ignores entirely the mass of evidence from crossing-over, which forms one of the main proofs of the theory, the other being the conception of mutation. For the gene, Russell would substitute a kind of holistic moving equilibrium of the germ cells, which is unanalytical and leaves unexplained the phenomena of crossing-over.

That the gene is not a representative particle, but a stable, physiological unit, is shown by a mass of evidence from plant and animal genetics. I will only cite the work of Dobzhansky (1927, 1930) in showing that each gene affects not one character, but many. Taking one series of allelomorphic eye-colours in *Drosophila*—red, eosin, ivory, and white, with diminishing amounts of pigment—he shows that the form of the spermathecae is also affected by these genes, but in different order, and that the testes of the red-eyed wild fly are yellow while those of the three mutations are transparent. A still more cogent series is that of the three allelomorphs, stubble, stubbloid, and wild type. Stubbloid is a recessive gene, which reduces the length of the bristles when present in two doses, while stubble is dominant, a single dose reducing the bristles rather more than two doses of stubbloid. These genes both reduce also the size of wings and legs, but here the effect is reversed, stubbloid producing more reduction than stubble. Moreover, stubble affects most strongly the abdominal and scutellar bristles, weakly the inner vertical bristle; while the reverse is true of stubbloid. In addition, stubbloid decreases the branching of the arista, while stubble has no such effect. This disproportionality of the effects of these two genes on various organs appears to rule out any merely quantitative interpretation of the nature of the genes. Similarly, R. Anderson (1931) has recently shown that bar-eye differs from wild type not only in the reduced number of facets, but also in reduced head width, haltere length, thoracic length, wing length and width, and in size

of the median ocellus, while the numbers of acrostical and of ocellar hairs is increased.

Geneticists are agreed, from such evidence as this, that each gene affects many parts of the soma in its development. The wider generalization, that a particular gene or mutation is represented in every cell, and is therefore potentially capable of affecting all parts of the body, is especially clear in plants (Gates, 1915). From this point of view the problem of development is an analysis of the effects of the gene-products upon each other in their reactions with the cytoplasm and the environment. Lillie (1927), in an able and incisive survey of the relations between genetics and embryological development, points out some of the difficulties with the view that the nuclei in ontogeny all retain a complete set of genes, and shows that neither genetics nor physiology has yet given us the least clue to the nature of embryonic segregation and organ development in its time sequence. His stimulating criticism is a valuable reminder that embryologists and geneticists combined are still far from any adequate understanding of the events of animal ontogeny.

Returning again to the chromosome, whether each visible chromomere contains a single invisible gene must remain for the present an open question. The numerous long, thready chromosomes in some of the Radiolaria, Heliozoa, Diatoms, and other Protista give a strikingly similar picture to those found in higher organisms. But it is impossible to believe that these chromosomes of the Protista are as highly differentiated along their length as the chromosomes of higher plants and animals are according to genetic theory. It is evident that the mitotic mechanism was evolved among the Protista, and we may regard this as a remarkable case of nomogenesis according to the conception of Berg. Each of the many chromosomes in such an organism as *Thalassiosira nucleata* may be homogeneous along its length. If that is so, then it follows that the gene mutations on which the evolutionary progress of higher organisms is based have in many cases resulted from a difference arising between two adjacent genes or granules which were previously alike. I believe we have here an important basis for evolutionary progress—a factor which has hitherto been overlooked.

However much alike the chromosomes of lower and higher organisms may appear as stained structures, it must be assumed that the latter are much more highly differentiated, containing many chemically unlike packets, whereas the core of each chromosome in some of the simpler Protozoa may contain but one. According to this view, progressive evolution has seen a steady increase in the number of the genes, from a condition in which each chromosome contains a single kind of genic material to one in which thousands of chemically different packets of material are represented. The mitotic mechanism, once evolved, has in this sense made possible the subsequent phases of organic evolution. It is also worth while pointing out that genes, like chromomeres, may perhaps differ markedly in size; and if that is so, it is quite possible that when a larger gene mutates it divides into two

parts, one remaining of the old type and the other being changed into something new. We might, then, think of the genes as becoming progressively smaller, until some at least reach a minimal size, below which their persistence as stable units is impossible. It is possible that the shortening of some chromosomes may take place through the loss of genes which have fallen below the level for persistence.

Whether any particular chromosome is homogeneous or differentiated along its length, the forces involved in its longitudinal splitting are probably the same. Whatever their biological significance, these forces must obviously be physical in nature. The split in the substance (matrix) of the chromosome is, as we have seen, preceded by a split in the chromonema, and this in turn must be preceded by some process of duplication of the axial chain of genes which gives the whole structure its extraordinary stability. Alexander and Bridges (1928) have discussed this subject, the reproduction of the gene, basing their views on Troland's theory of autocatalysis. We cannot enter into the matter in detail here, but will only remark that this theory assumes that the duplication of a gene can be likened to a process of autocatalysis, while its interaction with other constituents in the nucleus is probably one of heterocatalysis. Since Wilson suggested that the chromosomes contain enzymes which catalyse specific reactions in development, this view has become increasingly acceptable.

The question how the genes are duplicated so as to form a double series brings us again clearly to the border-line between the organic and the inorganic. For on the one hand the genes must be composed of a group of like or unlike molecules, and derive some of their peculiar properties from their form of aggregation, and on the other hand they must have properties other than those, such as cohesion and adhesion, which ordinary molecular aggregates possess. There appear to be two possible views as to how genes divide: (1) by an addition and finally a regrouping of the molecules, followed by fission of the whole, (2) by a point-to-point addition of molecules to those already present and arranged in a single plane. This "pancake" view appears to be favoured by Bridges. The former hypothesis involves the essentially organic process of fission, while the latter, although essentially inorganic, requires an amount of structural stability such as inorganic substances, with the exception of crystals, do not possess.

A large amount of cytological evidence from various sources appears to necessitate the hypothesis that the attraction which homologous chromosomes usually show for each other relates not merely to these bodies as wholes, but is derived from the specific attractions between their corresponding chromomeres or genes. An ordinary nucleus will, then, exhibit hundreds, if not thousands, of these specific attractions, and if a portion of a chromosome is displaced or translocated to another chromosome its specific attractions remain unaltered. In a number of such cases in *Drosophila*, some of them produced by treatment with X-rays, a section of one chromosome has become intercalated in or attached to another, the translocation being shown by the

new genetic linkages and confirmed cytologically by examining the chromosomes. The disturbed crossing-over relations show that the genes retain their specific attractions, however their positions in the chromosomes may be altered. The names of Muller, Stern, and Dobzhansky have been particularly connected with this work. Nothing like these specific attractions is known in the inorganic world, for Mendelian behaviour shows that the units pair without undergoing chemical reaction, and the existence of such attractions makes it necessary to assume that the particles (chromomeres or genes) between which they occur belong definitely to the organic order of existence.

This attraction between homologous chromosomes varies greatly in the somatic tissues of different organisms, being very intense in some of the Diptera, clearly marked in some plants, but apparently non-existent in the ontogeny of many plants and animals. In all, however, at the time of meiosis, the chromosomes not only change their shapes, but take on a strong, mutual attraction, which may be regarded as sexual in character. We are quite without any basis for an explanation of this phenomenon at the present time, and even a knowledge of how genes divide would not appear to help us. This force of attraction bears some resemblance to cohesion, but it is exerted at a distance which, although microscopic, is greater than molecular dimensions. It is possible that these attractions may be controlled by the pH and other features of the medium, and by the electric charges which the chromosomes undoubtedly bear at certain stages in mitosis.

Belling (1927) originated the hypothesis of specific attractions between the like ends of chromosomes, to account for the linkages which were observed between certain chromosomes of *Datura*. He suggested that the formation of chromosome rings was due to interchange of segments between non-homologous chromosomes. Since then the hypothesis has been widely applied to a variety of cytological problems. Nevertheless, it has its limitations, and pairing cannot therefore be taken as proof of homology, nor can an absence of pairing in meiosis be accepted as necessarily showing a lack of homology. Heilborn (1930) has shown that when certain apple varieties are subjected to a high temperature (35° C.) the meiotic chromosomes will not pair, but remain univalent. Takagi (1928) used similar methods with *Lychnis Sieboldii*, obtaining non-conjunction of the 24 chromosomes as well as other irregularities in the pollen mother-cells. Sax (1931²) has very recently produced temporary asynapsis in *Rhæo discolor* by subjecting plants to low temperature. Beadle (1930) has described a mutation in maize which shows complete pollen sterility and a high degree of seed sterility. This is because the chromosomes fail more or less completely to pair, the condition being called "asynapsis." It is inherited as a Mendelian recessive. In *Drosophila* a Mendelian gene has been found (Gowen, 1928) which inhibits crossing-over in all the chromosomes of the female, presumably because they do not undergo synapsis, and Blakeslee appears to have found a similar mutation in *Datura*. Finally may be mentioned the case of *Viola orphanidis* (Clausen,

1930), in which different plants have 20, 21, or 22 chromosomes. In a strain derived from the Edinburgh Botanic Garden all the progeny having 20 chromosomes are male-sterile, the chromosomes failing to conjugate in meiosis, while on the female side they pair normally. Hence it is evident that various genic conditions as well as external effects may suppress the sexual attraction between chromatic elements which normally brings about synapsis. The occasional pairing of certain meiotic chromosomes in haploid plants indicates that in some plants non-homologous chromosomes may also have certain chromomeres in common, but occasionally the amount of such pairing is so great as to make it highly improbable that only homologous chromomeres are involved.

That genetical crossing-over only occurs when the chromosomes pair in synapsis is clear from various lines of evidence. We have already seen that the chromosome is a structural unit, because, for some unknown reason, adjacent chromosomes do not normally fuse by their ends. But the abundant facts of crossing-over show that any given chromosome may change a considerable portion of its gene content during meiosis. In this connection it is worth while recalling the prescience of Farmer's (1907) statement in his Croonian Lecture to the Royal Society. "The chromosomes . . . represent similarly organized groups of chromomeres, but they would not necessarily represent permanent or persistent structures in the sense that each one is to be looked on as being invariably composed of the same chromomeres."

One further matter may be briefly considered. What is the relation, if any, between crossing-over and mutation? This question could be more easily answered if we knew exactly what happens in a gene mutation. The association between reversion at the bar-eye locus in *Drosophila* and crossing-over in that region of the chromosome is well known, but no satisfactory explanation is yet available. Probably further experimentation with X-rays will throw more light on the subject. Sax (1931¹) has recently pointed out a high correlation between crossing-over frequency and mutation frequency in particular parts of the chromosomes. Thus in the region of the spindle fibre attachment of the third chromosome of *Drosophila* there are few cross-overs and few mutations. The same is true of chromosome II and of the X. The possible interpretation of those facts would take us too far into current genetic theory.

We may only conclude that the ultimate nature of the gene is of fundamental importance in biological theory, and we shall some day see more clearly exactly where the limitations of the gene theory lie. The last two decades have witnessed such great advances both in genetics and cytology that the two fields have been welded into one. Now that what we may call the external and internal evidence can both be brought to bear on any genetical problem, advances in our knowledge of the nature, evolution, and meaning of nuclear structure may be expected to be more rapid than ever before.

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597: II.—THE OTOLITHS OF EIGHT SMALL EELS FROM THE ETANG
639. 389. DE VACCARÈS.

By Professor A. GANDOLFI HORNYOLD, D.Sc., F.Z.S., F.R.M.S.

(Read February 17th, 1932.)

TWO PLATES.

ON the 10th of December, 1930, I made an excursion to the Etang de Vaccarès near Arles to obtain eels for my work on age and growth. The Société Nationale d'Acclimatation de France has made a zoological and botanical reserve there, and I can only advise all friends of nature to visit it. It is impossible not to admire its beauties, and the reserve renders already great services for the protection of bird life. Thanks to the kindness of Prof. Bressou, Secrétaire General of the society, and of M. Tallon, director of the Reserve Zoologique et Botanique de Camargue, I obtained a large number of yellow and silver eels, and I express to both my sincerest thanks, as also to the society.

Eel otoliths from an unknown locality are rather like a lottery ticket as regards their suitability for age determination. In some localities the otoliths are transparent and one can count the zones without difficulty after clearing in creosote, terpinol, etc. In others they are more or less opaque, and need grinding down before it is possible to count the zones. But the worst case of all is that when the otoliths are transparent and the zones are faint and often very indistinct. This was so much the case here that I gave up the work, as it was quite impossible to obtain accurate results.

I found also very many irregular forms, and I picked out the eight most curious of the forms of saccular otoliths for morphological work. M. Fernand Angel of the Muséum National d'Histoire Naturelle of Paris most kindly made the drawings of the otoliths, and my thanks are due to him for all the pains he took to render the otoliths so perfectly.

I begin by giving the sex, the length, the weight of the eight eels, and the dimensions of their otoliths, as also the magnification.

Sex. Length. Weight.			Dimensions of the Otoliths.				Magnification
	cm.	gr.	mm.		mm.		
♀	46	148	Fig. 1	Left 2.7 × 1.7	Fig. 2	Right 2.7 × 1.7	× 20
„	44	133	„ 3	„ 2.5 × 1.4	„ 4	„ 2.5 × 1.4	× 20
♂	42	106	„ 5	„ 2.5 × 1.9	„ 6	„ 2.5 × 1.9	× 20
„	40	102	„ 7	„ 2.3 × 1.6	„ 8	„ 2.3 × 1.6	× 22
„	37	72	„ 9	„ 2.7 × 1.7	„ 10	„ 2.7 × 1.7	× 20
„	36	85	„ 11	„ 2.3 × 1.5	„ 12	„ 2.3 × 1.5	× 22
„ ?	33	50	„ 13	„ 2.0 × 1.5	„ 14	„ 2.0 × 1.5	× 25
♀	31	40	„ 15	„ 1.9 × 1.3	„ 16	„ 1.9 × 1.3	× 29

This table confirms my previous observations, showing that both the saccular otoliths can be of the same size, or that they can differ more or less. In this case all the otoliths were of the same size, and it is the first time that I have observed this. The size of the otoliths is not in absolute proportion to that of the eel, and those of the 37 cm. silver male are as large as those of the 46 cm. yellow female.

The left otolith of the 46 cm. yellow female (pl. I, fig. 1) is elongated, the dorsal rim is curved with some indentations towards the posterior rim, the ventral rim is straight and serrated nearly all along. The posterior rim is curved and serrated. There is neither antirostrum nor excisure, and the rostrum is large and slightly flattened. The opening of the wide straight undivided sulcus covers the greater part of the frontal rim. The sulcus ends rounded at about four-fifths of the length of the otolith. Near the opening it slopes down gradually on the ventral side, but towards the end it becomes steeper.

The right otolith (pl. I, fig. 2) is less elongated and more ovate; both the dorsal and ventral rims are curved with fewer indentations than in the left otolith, and the posterior rim is rounded and serrated. There is neither antirostrum nor excisure, and the rostrum is small and flattened, with a slight notch forming thus two small ridges. The wide, undivided, slightly oblique sulcus opens out widely on the frontal rim, and ends in a point at about four-fifths of the length of the otolith. On the dorsal side the sulcus has a deep narrow channel, but on the ventral side it slopes down so very gradually, especially towards the opening, that the contour is not very distinct.

The left otolith of the 44 cm. silver female (pl. I, fig. 3) is elongated, the dorsal rim is curved with a few indentations, the ventral rim is straight but serrated all along, and the posterior rim is rounded and serrated. The antirostrum is small and forms a point, and the rostrum is large and blunt. An excisure is present. The narrow, undivided, slightly curved sulcus opens out widely on to the dorsal part of the rostrum, and ends rounded at about three-quarters of the length of the otolith. The sulcus forms a deep narrow channel on the dorsal side, but on the ventral side it slopes down gradually.

The right otolith is also elongated (pl. I, fig. 4), the dorsal rim is curved and serrated towards the posterior rim, the ventral rim is nearly straight, but serrated all along, and the posterior forms a protuberance. The antirostrum is small and pointed, and the rostrum is large and forms a sharper point than in the left otolith. The narrow, deep, slightly curved, undivided sulcus opens out widely on to the dorsal part of the rostrum and ends rounded at about three-quarters of the length of the otolith. Near the opening the ventral side of the sulcus slopes down gradually.

The left otolith of the 42 cm. silver male (pl. I, fig. 5) is ovate, both the dorsal and ventral rims are curved and slightly serrated. The posterior rim has a deep indentation near the dorsal rim, and two rounded protuberances below it, the one nearest the ventral rim being the larger. The antirostrum is small, the rostrum large, and both are rounded. An excisure is present.

The very wide, undivided, slightly oblique sulcus opens out very widely on to the dorsal part of the rostrum, and ends rounded at about four-fifths of the length of the otolith. On the dorsal side of the sulcus there is a deep channel, but on the ventral side it slopes down gradually. The contour, however, is distinct.

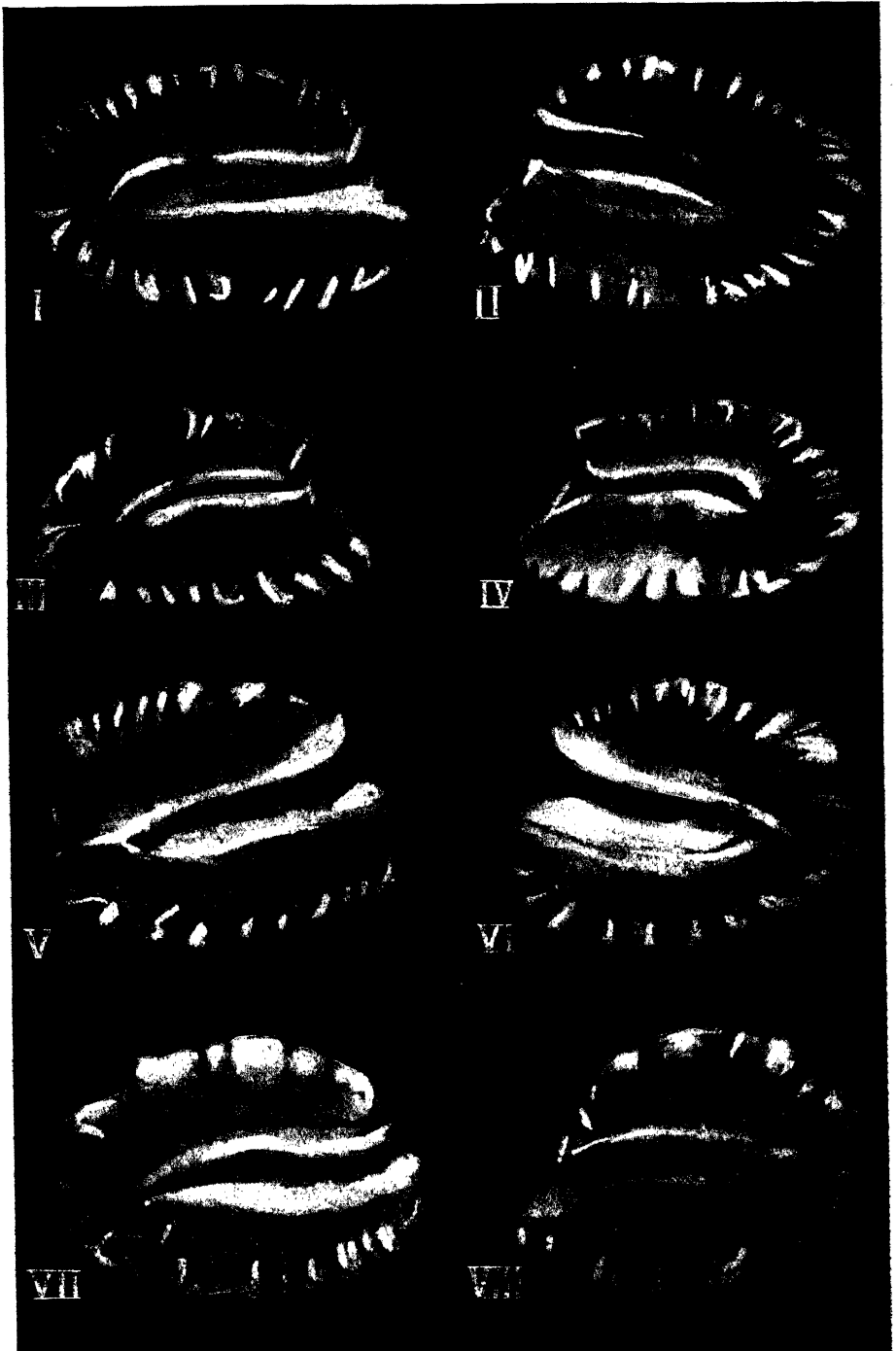
The right otolith (pl. I, fig. 6) is even more ovate, both the dorsal and ventral rims are curved and serrated. The posterior rim forms a pointed protuberance. The antirostrum is fairly large and rounded, the rostrum large and slightly flattened. An excisure is present. The very wide, slightly oblique, undivided sulcus opens out widely on to the dorsal part of the rostrum, ending in a point at about four-fifths of the length of the otolith. The dorsal side of the sulcus is deep and the ventral side slopes down gradually, but the whole contour is distinct.

The left otolith of the 40 cm. silver male (pl. I, fig. 7) is elongated, the dorsal rim is curved with few indentations, the ventral rim is curved and serrated towards the rostrum. The posterior rim is flattened with a small point in the centre. There is neither antirostrum nor excisure, and the rostrum is formed by two small rounded protuberances. The wide, straight, undivided sulcus opens out on the dorsal side of the rostrum, covering completely the dorsal protuberance, and ends in a point at about four-fifths of the length of the otolith. On the dorsal side there is a deep, wide channel, but on the ventral side the sulcus slopes down gradually, but the contour is quite distinct.

The right otolith (pl. I, fig. 8) is ovate, the dorsal rim curved and serrated towards the posterior rim, the ventral rim is straight but indented towards the rostrum. The posterior rim is rounded and serrated. There is neither antirostrum nor excisure, and the rostrum is flattened with a small notch in the centre. The sulcus is less wide, straight and undivided, opening out on to the dorsal side of the rostrum, and ending indistinctly near the posterior rim in a point. The dorsal side has a deep, wide channel, and the ventral side slopes down. The contour becomes indistinct towards the end.

The left otolith of the 37 cm. silver male (pl. II, fig. 9) is elongated, the dorsal rim is curved and slightly serrated towards the posterior rim, the ventral rim is nearly straight and serrated towards the rostrum. The posterior rim is rounded and serrated. The antirostrum is large and forms a blunt point, and the rostrum is large, flattened with two small notches. An excisure is present. The very wide, straight, undivided sulcus opens out widely on to the dorsal part of the rostrum, and ends rounded at about four-fifths of the length of the otolith. The sulcus slopes down on both sides, but more so on the ventral side, and the contour is fairly distinct.

The right otolith (pl. II, fig. 10) is more ovate, the dorsal side is curved and serrated nearly all along, the ventral rim is straight with a few slight indentations towards the posterior rim. The posterior rim is flattened and indented. The antirostrum is fairly large and forms a sharp point, and the



rostrum forms a curious flattened protuberance. An excisure is present: The wide, straight, undivided sulcus opens out widely on to the dorsal part of the rostrum, ending rounded at about nine-tenths of the length of the otolith. On the ventral side the sulcus slopes down gradually, especially near the opening, where the contour is not very distinct.

The left otolith of the 36 cm. silver male (pl. II, fig. 11) is more ovate, the dorsal rim is curved with slight indentations towards the frontal rim, the ventral rim straight, and the posterior rim forms three protuberances, the dorsal and central ones slightly pointed, and the ventral one rounded. There is neither antirostrum nor excisure, and the rostrum is large and rounded. The wide, straight, undivided sulcus opens out widely on to the frontal rim and tapers down to a point at about four-fifths of the length of the otolith, and ends indistinctly on the posterior rim between the dorsal and central protuberances.

The right otolith (pl. II, fig. 12) is ovate, the dorsal rim is curved with few indentations, the ventral rim is straight, and the posterior rim flattened and oblique with two notches. The antirostrum is a small point and the rostrum is large and obtuse. The curved undivided sulcus opens out widely on to the frontal rim and tapers down gradually till about four-fifths of the length of the otolith, where it becomes shallow and ends on the posterior rim in the upper notch. The sulcus slopes down gradually on the ventral side, and towards the end the contour is not very distinct.

The left otolith of the 33 cm. yellow eel of undeterminable sex (pl. II, fig. 13) is ovate, the dorsal rim is curved and serrated towards the frontal rim, the ventral rim is nearly straight with a few small indentations towards the rostrum. The posterior rim is flattened, slightly oblique and serrated. The antirostrum is large and pointed, and the rostrum is large, rounded and serrated. An excisure is present. The wide, slightly curved, undivided sulcus opens out widely on to the dorsal part of the rostrum, and gradually tapers down, and at about four-fifths of the length of the otolith there is a slight ridge. The sulcus then widens out again, ending with a very wide opening which covers the greater part of the posterior rim. The dorsal side as far as the ridge is delimited by a deep narrow channel, but on the ventral side it slopes down very gradually.

The right otolith (pl. II, fig. 14) is ovate, the dorsal rim is very curved and serrated, and the ventral rim is less curved with few indentations. The posterior rim has a curious protuberance which might be compared to a fish tail. The antirostrum and rostrum are large, both rounded. An excisure is present. The sulcus is wide, straight, and undivided, ending on the posterior rim in the centre of the protuberance. On the dorsal side the sulcus is sharply delimited by a deep channel which, at about four-fifths of the length of the otolith, ends in a curve. A narrow, shallow channel continues as far as the posterior rim. On the ventral side the sulcus slopes down very gradually, and the contour is indistinct.

The left otolith of the 31 cm. yellow female (pl. II, fig. 15) is ovate, the

dorsal rim is curved, as also the ventral rim, the latter being deeply indented. The posterior rim forms a large pointed protuberance. There is neither antirostrum nor excisure, and the rostrum is very large and rounded. The very wide, straight, undivided sulcus opens out widely on to the frontal rim, and ends rounded at about two-thirds of the length of the otolith. On the dorsal side the sulcus forms a deep channel, but on the ventral side it slopes down gradually; the contour, however, is indistinct.

The right otolith (pl. II, fig. 16) is ovate, the dorsal rim is very curved with deep indentations, the ventral rim nearly straight and slightly serrated. The posterior rim ends in a blunt protuberance with a slight notch below. The antirostrum is small and rounded, and the rostrum large and slightly flattened. An excisure is present. The wide, straight, undivided sulcus opens out widely on the dorsal part of the rostrum, ending rounded at about two-thirds of the length of the otolith. The deep channel on the dorsal side of the sulcus is wide, and the ventral side does not slope down so gradually as was the case in the left otolith.

If we compare the sixteen figures representing the left and right otoliths of eight small eels measuring 31–46 cm. we can observe that no two otoliths, even those from the same eel, are identical, but all vary more or less, either in their form, or in that of the sulcus, or in both.

The serrated rims of the otoliths are usually due to crystallizations of calcite. The eel otoliths are composed of calcite, aragonite, and organic matter.

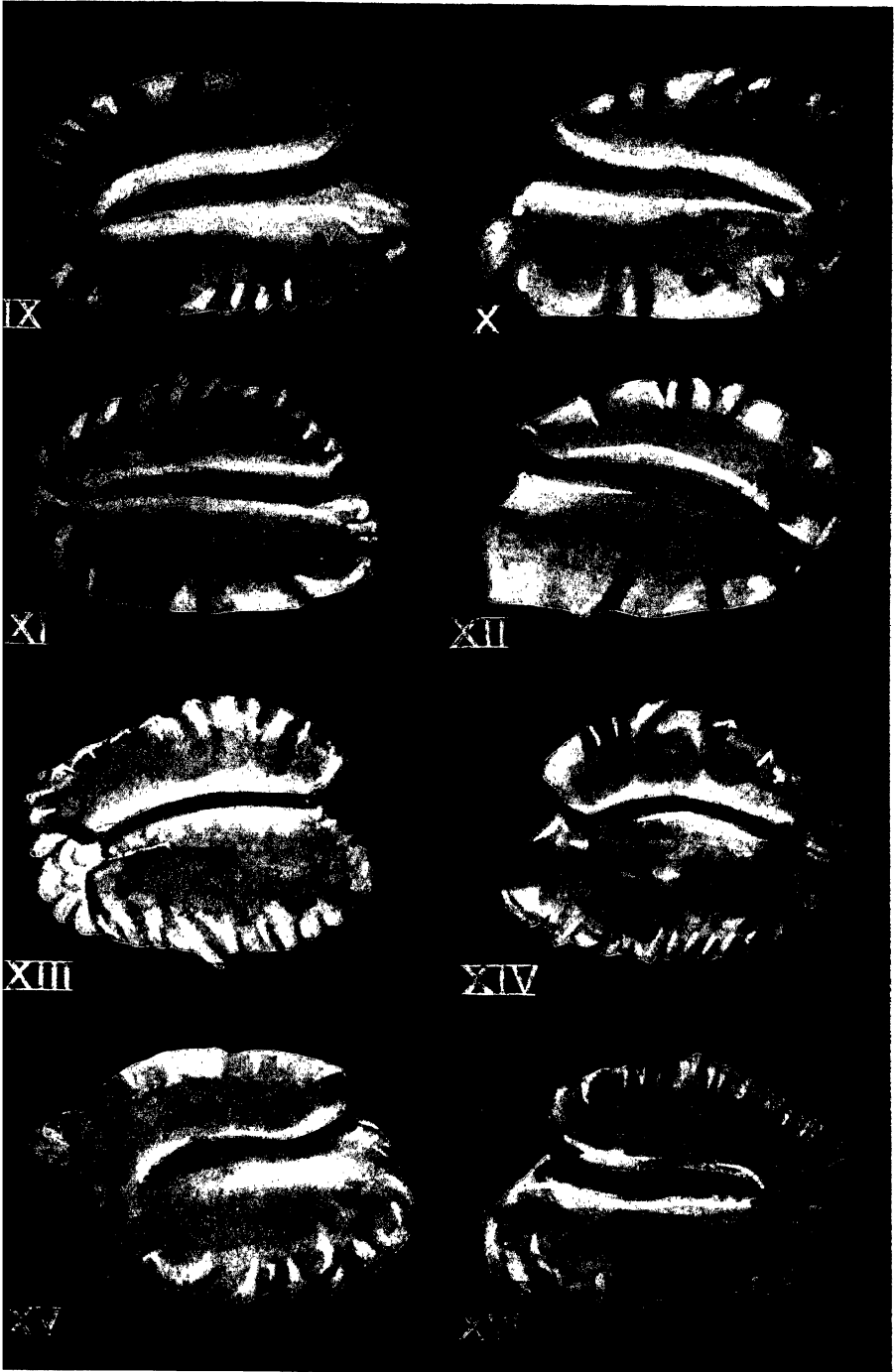
In some cases the irregularities are more or less similar in both otoliths, as in the case of the absence of the antirostrum and the curious form of the rostrum of those of the 40 cm. silver male (pl. I, figs. 7 and 8). The rostrum of the left otolith is formed by two small rounded protuberances, and the right otolith is flattened with a small notch in the centre.

The otoliths of the 46 cm. yellow female (pl. I, figs. 1 and 2) has also no antirostrum, and both have a more or less flattened rostrum, but the right otolith has a notch in the centre of the rostrum. The form of the sulcus differs; that of the left otolith is straight and round ended, and the sulcus of the right otolith is much narrower and ends in a point.

Another case is that of the rostrum of both the otoliths of the 37 cm. silver male (pl. II, figs. 9 and 10). The left otolith has a flattened rostrum with two notches, and the rostrum of the right otolith forms a large flattened protuberance, and is certainly the most curious form of rostrum I have ever met with.

The posterior rim of both otoliths of the 31 cm. yellow female (pl. II, figs. 15 and 16) forms protuberances; that of the left otolith is pointed, and that of the right otolith blunt.

It is the first time that I have met with a serrated frontal rim of the rostrum, as is the case in the left otolith of the 33 cm. yellow eel of undeterminable sex (pl. II, fig. 13), and the serrated posterior rim, as also the form of the sulcus, are most curious. The posterior rim of the right otolith ends



in a curious protuberance which can be compared to the form of a fish tail (pl. II, fig. 14).

One can easily find other examples by comparing the figures. The excisure is often very large, and the antirostrum and rostrum form right or even obtuse angles (pl. I, figs. 3, 4, 5, and 6, and pl. II, figs. 9, 10, 13, 14, 15, and 17). Some of the otoliths are of a more or less clupeoid type (pl. I, figs. 3, 4, and 5, and pl. II, figs. 9, 10, 13, 14, and 15), which is the normal form. In no instance was the sulcus divided into ostium and cauda.

This paper shows once more that the otoliths of quite small eels may show considerable variation, either in form or in that of the sulcus, or even in both.

These irregular forms of otoliths are often most curious, and in some localities, such as the Etang de Vaccarès, irregular forms of otoliths of the eel seem to be more often met with than in other localities.

77. 035. III.—PHOTOMICROGRAPHY OF AMPHIPLEURA PELLUCIDA.

By A. P. H. TRIVELLI and E. LINCKE.

(COMMUNICATION No. 477 FROM THE KODAK RESEARCH LABORATORIES.)

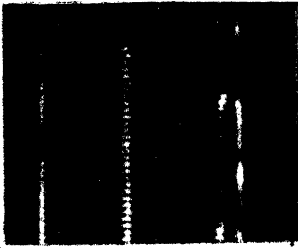
(Communicated by Mr. J. E. Barnard, December 16th, 1931.)

ONE PLATE AND ONE TEXT-FIGURE.

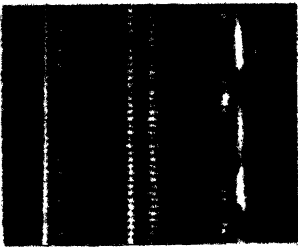
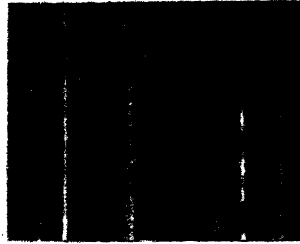
Introduction.—According to R. Neuhauss (1907), Woodward was the first to secure photomicrographic resolution of the structure of *Amphipleura pellucida* into lines. In 1886 H. van Heurck confirmed this result. Fraenkel and Pfeiffer (1889), according to R. Neuhauss, showed photomicrograms of this diatom in which the lines were resolved into dots. In 1890 H. van Heurck, and in 1893 E. Zettnow, also succeeded in this by the use of a Zeiss apochromat with a numerical aperture of 1.6, computed by Czapski. Previous measurements had already shown that *Amphipleura pellucida* contains from 40 to 42 lines (which are rows of dots) per 10μ , and Zettnow was able to count 52 dots per 10μ , which corresponds with about 100,000 lines and 130,000 dots per inch. The light used was filtered through a cuprammonium salt solution and an iodine solution in chloroform, combined with oblique illumination. The diatom was mounted in a mercury-iodide salt. For complete resolution of the dots in the extreme violet Zettnow considered it necessary to use an objective with a numerical aperture of 1.6 and to mount the diatom in a colourless medium having a refractive index of 2.0. Mounted in realgar with a refractive index of 2.4, and using blue light, an objective with a numerical aperture of 1.9 to 2.0 should be used. The refractive index of the diatom is 1.43.

Since then several microscopists have been able to resolve the lines of *Amphipleura pellucida* into dots with more or less success. Special mention should be made of the micrograms of R. Neuhauss (1907) and A. Köhler (1909), who succeeded in getting excellent results with oblique ultra-violet light of wave-length $275m\mu$.

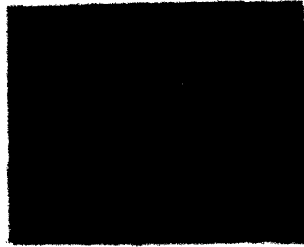
During the past year one of us, with L. V. Foster (1931), has made the application of the $365m\mu$ radiation of the mercury arc practicable for photomicrography. An objective with a numerical aperture of 1.3 was constructed. In $365m\mu$ radiation this gives the same theoretical resolution as given by an objective with a numerical aperture of 1.6 in blue light of $450m\mu$ wave-length, which is about the average transparency of the blue Wratten C filter. Use of the mercury arc also made possible the investi-



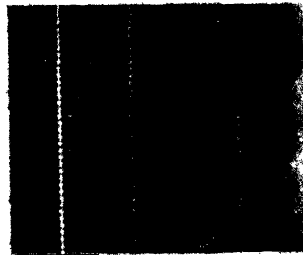
60° YELLOW 25°



45° GREEN 25°



30° VIOLET 25°



ULTRA-VIOLET 25°

MAGNIFICATION 4000X

gation of the resolving power in oblique illumination with practical monochromatic light. This gives much more definite results than if bands of the spectrum are used, such as results from the use of filters with a ribbon filament lamp.

The Equipment.—For our investigations a quartz mercury vapour lamp of the atmospheric pressure type was used (Kelvin, Bottomley, and Baird, Ltd., London) with the special micro outfit working at 220 volts, the starting current being 4.4 amperes, soon reduced to a running current of 2.2 amperes. This lamp gives a very intense and constant light. For the isolation of the various emission lines of the mercury spectrum we used a Wratten filter No. 22 to transmit 579 and 577m μ (yellow); Wratten filter No. 77 to transmit 546m μ (green); Wratten filter No. 50 to transmit 436m μ (violet); Wratten filter No. 18A to transmit 365m μ (ultra-violet).

The micrographic outfit can be used without condenser lens. An aplanatic condenser (Bausch and Lomb) of very high aperture can be used for the Köhler illuminator. The glass of this condenser, however, has a high absorption for 365m μ radiation. For this reason we used a quartz condenser and with it were able to make micrograms at a magnification of + 2500 in 5 seconds on a Speedway plate in 365m μ radiation.

Through the courtesy of Ward's Natural Science Establishment, Inc., Rochester, N.Y., U.S.A., we obtained a series of slides of *Amphipleura pellucida* in different mounting media made by Mr. John A. Long, in Leeds. This enabled us to compare the diatom mounted in air, Canada balsam, hyrax from Dr. Hanna, and styrax from four different sources (Kellner in Stuttgart, E. Thum in Leipzig, J. T. Norman and Darlaston, both in England); monobromide of naphthalene, fused piperine, piperine-coumarone, and gum dammar.

A Zeiss microscope stand 1B having a large mechanical stage was used. For the visible spectrum a Zeiss apochromat with a numerical aperture of 1.3 was employed. The microscope was mounted on a large Bausch and Lomb optical bench resting on a wooden platform, which was supported by two inflated automobile inner tubes to absorb all vibration. At one end of this optical bench was the camera, and at the other the light source. Between the microscope, the tube of which was in a horizontal position, and the light source were a filter holder, a water cell, and a shutter.

Discussion of the Results.—We observed that on the average the mounting media have little effect on the contrast of the lines and the dots of *Amphipleura pellucida*, which indicates that the dots do not, in all probability, form a structure on the surface of the diatom, but within the diatom scale. The effect of the mounting medium on the visibility of the resolved lines or dots seems to be determined therefore by the angle of oblique illumination, which increases with its refractive index.

To be useful, however, for the higher resolutions in the ultra-violet, the mounting medium must be transparent for the wave-length employed. This necessitated a preliminary investigation of the transparency for 365m μ radiation of the mounting media on the slides which Mr. Long had sent us.

The mounting medium here was spread out in a layer between slide and cover-glass in the thickness generally employed in microscopy. A beam of ultra-violet light was sent through the slide and its transparency observed on a barium platino-cyanide screen.

Naphthalene monobromide, fused piperine, and piperine-coumarone were found to be too opaque for any practical use in photomicrography with $865m\mu$ radiation. With a glass condenser in the lamp-house of the mercury arc, styrax from Thum, Norman, and Darlaston are also too opaque for

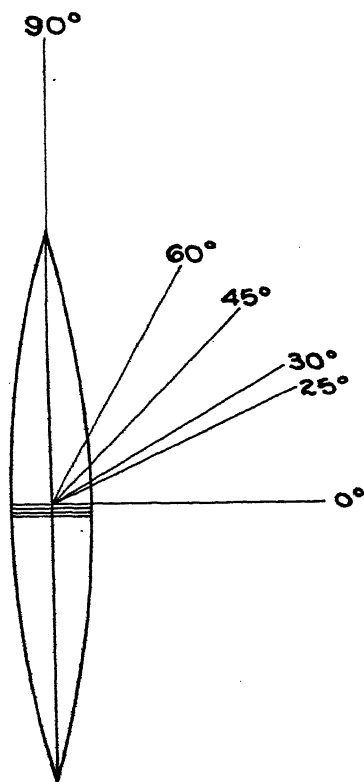


FIG. 2

practical use in ultra-violet photomicrography. Without the condenser, however, or with a quartz condenser in the lamp-house, these different forms of styrax are useful mounting media for near ultra-violet photomicrography; the best transparency was given by Kellner styrax. Hyrax, Canada balsam, and gum dammar have the highest transparency among the mounting media investigated. Air-mounted specimens gave only lines.

The best results in the resolution of *Amphipleura pellucida* were obtained using hyrax from Dr. Hanna. It was accordingly decided to continue all further investigations with this mounting medium only.

In *Amphipleura pellucida* having 100,000 lines to the inch the lines would be 0.25μ apart. Oblique illumination with the yellow mercury line would resolve, according to Abbe's formula, a distance of

$$\frac{\lambda}{2 \text{ N.A.}} = \frac{577}{2 \times 1.3} = 0.22\mu,$$

which means that the line structure of *Amphipleura pellucida* should resolve in this radiation.

The result is given in plate I. We used a diaphragm of 5 mm., which is moved 15 mm. out of the centre. The lines appear only by moving this oblique pencil of yellow light until an angle of 60 degrees or more is obtained, as is graphically represented in fig. 2. There is, therefore, a minimum angle of visibility. If the angle is 25 degrees, no lines are visible at all, as is shown in plate I. This also holds for the green mercury line, with the difference that the minimum angle of visibility is 45 degrees, no lines being visible at an angle of 25 degrees.

For the violet mercury arc line the minimum angle of visibility is smaller, and for the $365m\mu$ radiation the angle is still smaller. Near the minimum angle of visibility for violet and ultra-violet, however, the dots are resolved. The maximum visibility of the dots is at 30 degrees for $436m\mu$ wave-length, and at 25 degrees for $365m\mu$ wave-length.

In fig. 2 the different angles for the different colours are drawn in relation to the position of the diatom.

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582. 65. IV.—NOTES ON ZYGOSPORE FORMATION IN SPIROGYRA.

By PROF. R. RUGGLES GATES, F.R.S.

(Read May 20th, 1931.)

TWO PLATES.

FROM a collection of *Spirogyra* obtained in 1930 from Chelsea Physic Garden for class purposes, a series of preparations were made in the laboratory, showing conjugation. In looking over the slides some time afterwards, several interesting features regarding the production and germination of the zygospores were observed. They are the subject of the present note, and fresh material from the same source has been examined in this connection.

It was found that the material contained two distinct species, both forming zygospores. They are provisionally determined, from Pascher's *Süßwasserflora*, as near *Spirogyra fluviatilis* and *S. decimina* respectively, but it is not likely that these determinations are exact. My attention was first directed to the subject by the discovery of a double zygospore in one of the slides. So far as I am aware, there is no previous record of such an occurrence in *Spirogyra*, and we have found only one.

As shown in fig 1, the double zygospore is formed in the larger species (*S. fluviatilis*?) by two cells each conjugating as males with a very long cell of a female filament. This cell was presumably binucleate, but the cell wall which would normally be formed across its middle, at the point where both the zygospore and the cell wall show a constriction, has for some reason been inhibited. Careful search, with an immersion lens, for the remains of such a wall shows that it has never existed. That being the case, the spiral chloroplasts must have stretched continuously from one end of this double cell to the other. Observation of the double zygospore confirms the view that this was the case. The double zygospore presumably contains two nuclei, each diploid, and if these fused with each other before germination, a tetraploid nucleus would result, which would give rise, on germination, to a diploid instead of a haploid filament.

As fig. 1 shows, the outer wall is continuous around the whole double zygospore, although a constriction occurs in the median plane. With a low-power microscope there appeared to be an inner membrane which curved round and separated one zygospore from the other, but careful examination with higher powers shows that this is a false appearance, and that there is no line of separation between the two zygospores.

In the well-known paper by Gerassimov (1902) he describes the production of aberrant types of cells in *Spirogyra bellis* by cooling the filaments

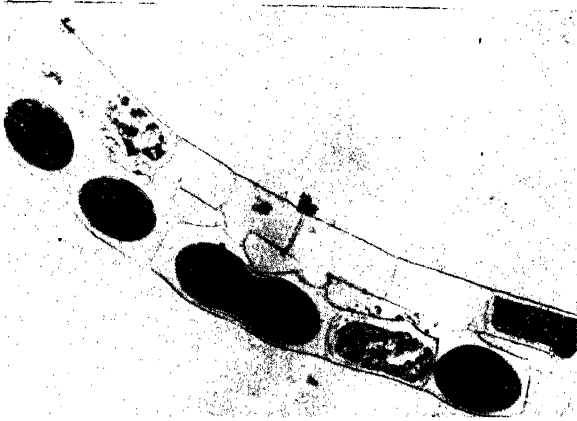


FIG. 1.

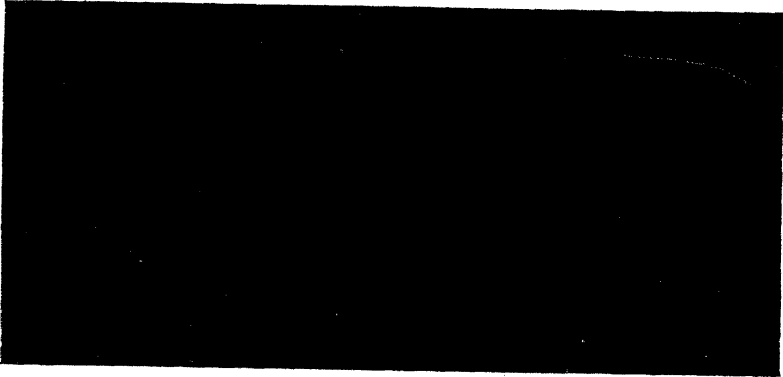


FIG. 2.

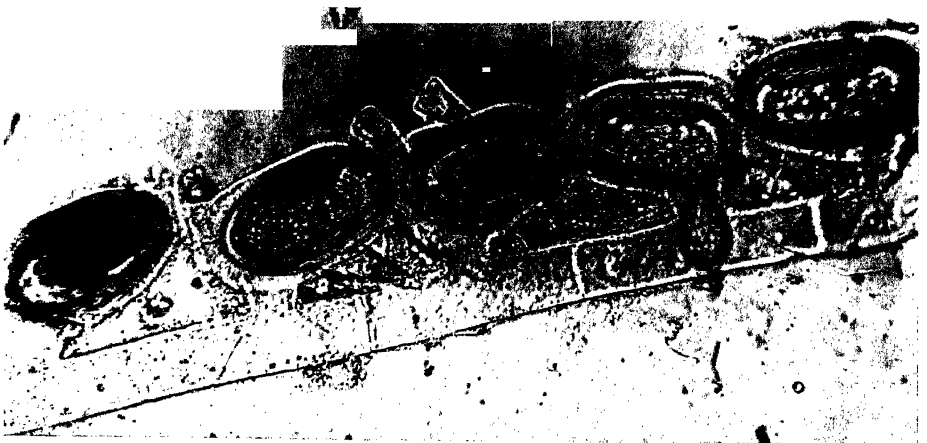


FIG. 3.

to 0° C. These included : (1) enucleate cells ; (2) larger (wider and longer) cells with a larger nucleus ; (3) large cells with two nuclei of normal size, but these nuclei are orientated both in the median plane of the cell. The large nuclei were probably diploid, and the cells containing them were larger both in length and width. Whole filaments of such cells were obtained, and some of these filaments conjugated afterwards. Similar experiments, including the use of anæsthetics, with several other species of Spirogyra are more fully described, particularly in two other relatively unknown papers by the same author (1898, 1900).

It is usually stated that filaments of Spirogyra, after conjugation, sink into the mud or are distributed by the wind, the zygosporcs undergoing a prolonged resting period before germination takes place. There is ample evidence, however, that in the smaller of the present species (*S. decimina* ?) germination of the zygosporcs is taking place at once. In fig. 2 is shown with higher magnification ($\times 660$) the germinating zygosporc of this species. It will be seen that the contents of the zygosporc are escaping surrounded by a thin inner membrane, while the two thick outer walls are separating. Numerous zygosporcs were in various stages of germination, although other filaments in the same material were filled with zygosporcs which had just been formed. The zygosporcs of this species are bright yellow and more or less elliptical (fig. 3, $\times 320$), and it will be seen that the cells containing the zygosporcs are already breaking apart. In fig. 4 ($\times 320$) are seen two zygosporcs of the larger species and an abnormal one of the smaller species, which will be referred to later. The zygosporcs of the larger species are more nearly round, bulging the cell wall (see figs. 1 and 4) ; they do not become yellow, but remain green, and take the stain of light green dissolved in lacto-phenol.

Another interesting peculiarity of this material already mentioned is that, as shown in figs. 3 and 4, a heavy yellow wall may be formed around the contents of the two fusing protoplasts before their fusion is complete. A number of such incomplete zygosporcs were observed. In both figures a portion of the male gamete is still in the male cell or in the act of passing through the connecting tube, when it and the fusing portion are quickly surrounded by a zygosporc wall. This shows that the secretion of this wall must be a rapid process. A sudden change in conditions, perhaps when the material was removed from the pond and placed in a jar, will probably account for this phenomenon.

Among the numerous observations of Lloyd (1926) on the behaviour of the protoplasts during the process of conjugation in Spirogyra, he also (1928) cites a case where, in *S. nitida*, conjugation fails to proceed, but globular masses of callose-like material are deposited chiefly on the inner surface of the cell wall near the articulation. In one instance, where the male gamete failed to form contractile vacuoles, it afterwards withdrew from the beak, and "in retiring had secreted a secondary cellulose wall plugging up the conjugation tube." It thus appears that anything which interferes with the process of conjugation may lead to derangements which take various forms.

In the same lot of my material, a third (undetermined but larger) species contained a number of filaments of two cells (fig. 5) from germinated zygospores, as well as several filaments of four and eight cells.

Finally, it may be pointed out that recent work on *Spirogyra* has given a different view of the early stages of conjugation. The observations of Czurda (1925) and Hemleben (1922), since confirmed by Lloyd (1928), and again recently, with full detail, in other species, by Hazel Saunders (1931), have shown that the filaments first adhere closely in pairs, being glued together by mucilage. The cells of one filament, which may be either the male or female, then put out a papilla, which induces papilla formation where it touches the opposite filament. The two papillæ are in contact from the beginning, and they elongate to form the conjugation tube, pushing the filaments apart as they grow.

The accompanying photomicrographs have been made by my laboratory assistant, Mr. C. S. Semmens.

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EXPLANATION OF FIGURES.

- Fig. 1.—Conjugating filaments of *Spirogyra fluviatilis* (?) showing a double zygospore. $\times 170$.
 Fig. 2.—Germinating zygospore of *S. decimina* (?). $\times 660$.
 Fig. 3.—Conjugating filaments of the last species, showing the cells containing zygospores breaking apart, and one case in which a thick wall has been formed around the zygospore before conjugation is complete. $\times 320$.
 Fig. 4.—Shows another incomplete zygospore like fig. 3, and two zygospores of the species in fig. 1. $\times 320$.
 Fig. 5.—Shows a filament of two cells from a germinated zygospore in a third species. $\times 300$.

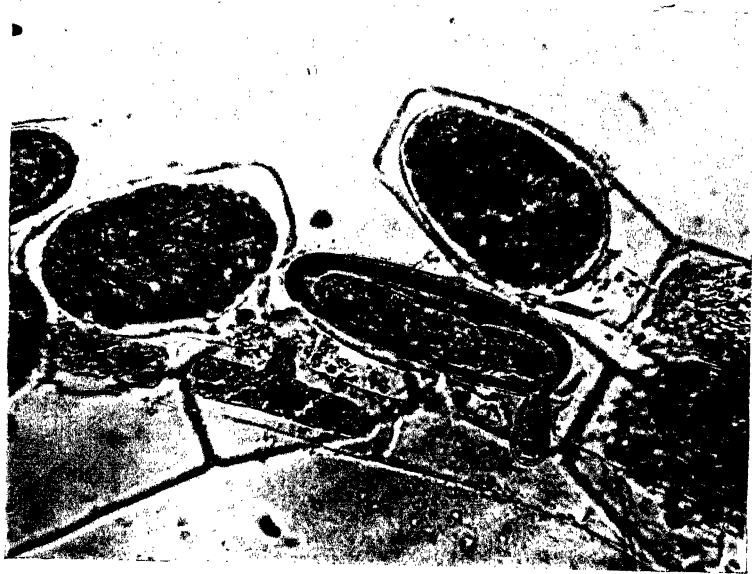


FIG. 4.

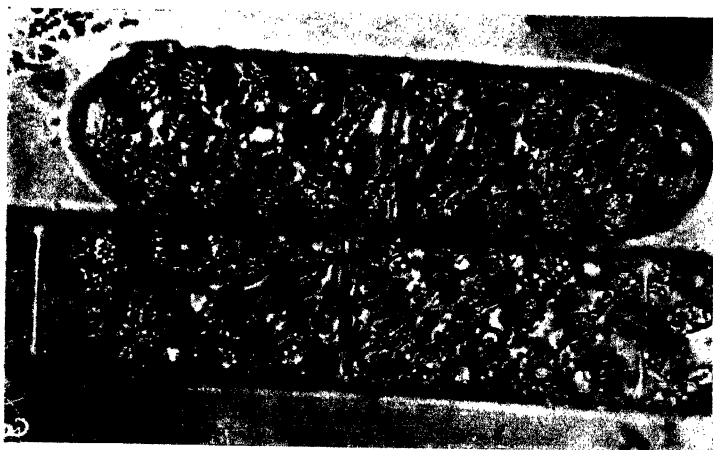


FIG. 5.

ABSTRACTS AND REVIEWS.

ZOOLOGY.

(Under the direction of G. M. FINDLAY, M.D.)

HISTOLOGICAL TECHNIQUE AND STAINING.

The Staining of Fat Glands in Total Preparations.—V. VRTIS ("Über elektive Färbung der Talgdrüsen mit Sudan III in den Totalpräparaten der Haut," *Ztschr. f. Wiss. Mikr.*, 1931, 47, 443-50). This method of staining in bulk has been applied mainly to the fat glands in the skins of rodents, and is useful for reconstruction. Portions of skin or whole small skins are fixed in 10 p.c. formalin, washed in water and in 50 p.c. alcohol for from 15 to 30 minutes. They are then stained for from 30 to 45 minutes in a saturated solution of Grüber's Sudan III in 70 p.c. alcohol, differentiated in 50 p.c. alcohol, the time required being from 30 minutes to several hours, rinsed in water and transferred to glycerine in which they eventually clear, the time required depending on their thickness. Preparations mounted in glycerine and sealed with Kitt wax have not faded for three years. Nile blue sulphate is not suitable for this technique, and Sudan III is the most satisfactory stain, fat glands, their outlets and branches appearing yellowish-red while all other tissues are more or less transparent.

G. M. F.

Hetero-dispersed Eosin Staining.—B. KEDROVSKY ("Anwendung von hetero-dispersem Eosin zur Färbung histologischer Präparate," *Ztschr. f. Wiss. Mikr.*, 1931, 47, 433-42). A modification of Dominici's technique is described, involving the use of a hetero- or poly-dispersed eosin. Material is fixed in Zenker's or Helly's fluid or neutral formol if the sheaths of connective tissue are to be examined, and is embedded in celloidin paraffin. Sections are stained for from 20 to 30 minutes in a solution prepared as follows: to 15 c.c. of a boiling 0.6 p.c. eosin solution (eosin reddish, König or Grüber) add 0.5 to 1 c.c. of 1 p.c. phosphomolybdic acid, and then 15 c.c. of a 1.2 p.c. cold aqueous orange G solution. This mixture must be freshly made every 3 or 4 days. Counterstain the sections in a 1 p.c. aqueous solution of toluidin blue for from 30 seconds to 1 minute and rinse. Differentiate slowly in 70 p.c. and 96 p.c. alcohol under the microscope. Pass into absolute alcohol and clear in bergamot oil and xylol; mount in balsam. Rose bengal and eosin BA may be used instead of eosin. Chromatin is stained dark blue or lilac, nucleoli red to orange, cytoplasm varies from blue to lilac, reddish or colourless; muscles red, Nissl's substance blue; red-blood corpuscles red.

G. M. F.

Sublimate Toluidin Blue for the Staining of Cilia.—P. HORVATH ("Sublimat-Toluidinblau für Cilienfärbung," *Ztschr. f. Wiss. Mikr.*, 1931, 47, 463-5). This technique is a modification of Gelei's osmium toluidin-blue method,

and gives more uniform and permanent results, besides being cheaper, owing to the absence of osmic acid. After centrifuging, pipette off the sediment and drop it into a concentrated solution of mercuric chloride; after 10-20 minutes wash in water; mordant in 0.33-1.65 p.c. phosphotungstic acid for from 10 to 15 minutes, discarding the mordant after use. Wash well in water; stain in toluidin blue for from 30 seconds to several minutes at 50-60° C., using a 1 in 1000 dilution for Holotrichida and 1 in 5000 for Hypotrichida; pass through the alcohols, xylol (three changes), and mount in balsam; all these manipulations are done by centrifuging. If organisms are mordanted after the original sublimate osmic fixation the staining is good, but tends to fade. Cytoplasm is light blue, cilia and basal bodies dark blue. G. M. F.

Capsule Staining.—E. E. ANTHONY ("A Note on Capsule Staining," *Science*, 1931, 73, 319-20). This method gives more reliable results than that of Hiss, and is eminently satisfactory for pneumococci. The best results are obtained with a 1 p.c. aqueous crystal violet solution (84 p.c. dye content). Air-dried, undiluted smears are stained for 2 minutes, washed in 20 p.c. aqueous solution of copper sulphate and dried. An increase in the time of staining did not improve the results. G. M. F.

The Staining of *Spirochæta pallida* in Sections.—R. FARRIER and A. S. WARTHIN ("A Study of the Effect of pH upon the Third Improved Warthin-Starry Method for Demonstrating *Spirochæta pallida* in Single Sections," *Amer. Journ. Syph.*, 1930, 14, 394). The importance of a suitable reaction for successful silver impregnation is demonstrated. Tissues are fixed in formalin, embedded in paraffin, and sections affixed to cover-glasses, passed through xylol and the alcohols to water. Using bromocresol green as indicator, a litre of water at pH 4.4 is prepared. From this a 2 p.c. silver nitrate solution is prepared, and for use is diluted to 0.5-1 p.c. Enough of this diluted solution is poured into a perfectly clean bottle so that when the cover slip is placed in it on edge the solution will cover the section by capillary attraction. The section is rinsed in the water at pH 4.4 and placed in the silver solution, with the section side next to the side of the bottle. Impregnation is allowed to proceed in darkness at 37° C. for 30 minutes, after which the cover-glass, section side up, is transferred to a small dish. 15 c.cm. of a 5 p.c. gelatine, heated to 45° C., are added to 3 c.c. of 2 p.c. silver nitrate solution; 1 c.c. of 5 p.c. hydroquinone is added and the mixture rapidly poured over the section. Reduction continues till the gelatine begins to turn brownish-black. Rinse and place in 5 p.c. sodium hyposulphite for a few minutes. Wash, pass through 96 p.c. alcohol, two changes of absolute alcohol, xylol, and mount in Canada balsam. G. M. F.

The Staining of Oocysts of Coccidia.—H. B. CROUGH and E. R. BECKER ("A Method of Staining Oocysts of Coccidia," *Science*, 1931, 73, 212-3). The faecal material is strained through a double layer of cheese cloth and centrifuged. More water is added and centrifugation is again performed, the whole process being repeated twice so as to remove most of the debris. Concentrated salt solution is added, the mixture shaken and centrifuged. The oocysts will appear on the surface, and are collected and transferred to a slide and covered with a cover-glass. The salt solution is replaced by glacial acetic acid by drawing it with the aid of blotting paper under the cover-glass, most of the oocysts being held in place by contact with the slide and cover slip. The slide is gently warmed for from 5 to 10 minutes, but without evaporating the acid. The acetic acid is then replaced by a freshly prepared 0.01 p.c. aqueous solution of Janus green in the same manner as before. Staining is continued for 10 minutes. Wash and stain with a concentrated solution

of aqueous eosin for 5 minutes. Wash, blot off excess of water, and seal with amber, vaseline or glycerine jelly. The oocyst jelly stains red, the walls may appear reddish and structures within the sporozoites are rendered visible. G. M. F.

A Modification of the Ehrlich-Biondi Stain.—J. O. FOLEY ("Studies in Stain Technic. III. A Cytological Method for Staining with the Ehrlich-Biondi Mixture," *Anat. Rec.*, 1931, 49, 15-7). Tissues are fixed either in Flemming's strong solution or in Allen's B15 without osmic acid. After removal of the paraffin, pass sections through potassium permanganate and oxalic acid and wash in running water. Mordant in 0.5 p.c. osmic acid if none was present in the fixative used; wash; prepare the following aqueous solutions: 0.23 p.c. methyl green, 0.11 p.c. acid fuchsin, and 0.1 p.c. orange G. These stains were Coleman and Bell's products with actual dye content given. Before using, mix in the following order: glycerine 10 c.cm., acid fuchsin 20 c.cm., orange G 30 c.cm., and then slowly and with constant stirring methyl green 30 c.cm.; stain for 12-24 hours in the mixture. Wipe off excess stain and blot lightly; immerse in 95 p.c. acid alcohol for 5-30 seconds, depending on the desired nuclear stages. Transfer to carbol-xylol, xylol, and mount. Results obtained with gonads of the mud minnow and white mouse were as follows: compact chromatin light green, less densely arranged chromatin blue-green, collagen bundles red, and cytoplasm brownish-yellow. G. M. F.

The Examination of Fats in Fæces.—L. D. HERTERT ("Differentiation of the Various Types of Fats by Means of Dyes," *Journ. Lab. & Clin. Med.*, 1931, 16, 926-9). Stools should be stained in the following mixture: Nile blue sulphate (National Aniline & Chemical Co.) 0.1 gm., glacial acetic acid 1 c.c., distilled water 100 c.c.; fatty acids stain a deep Nile blue, except oleic acid; neutral fats a deep red, approaching garnet; intermediate compounds a violet-purple or magenta. Cholesterol crystals stain as irregular blue rhomboids. A light Nile green is produced by a combination with plant or meat fibres, but more frequently these appear a deep blue; nuclei, if present, are sharply outlined. Crystals of fatty acids may also appear green, while neutral fats may be masked by fatty acids. Huepke's method may also be used. Mix a small piece of stool with a few drops of a saturated solution of cupric nitrate; heat, but do not boil. Metallic-green copper soaps are formed with fatty acids. Add a drop of 0.25 p.c. dimethylaminobenzaldehyde. Neutral fats stain a brilliant yellow with the latter reagent. If the stool is too acid and the red colour of the benzaldehyde obscures the yellow fat globules, neutralize with a little NaOH. A combination of the two techniques gives almost as much information as quantitative estimation of stools for the various fat fractions.

G. M. F.

A Stain for Metachromatic Granules.—H. A. KEMP (*Journ. Lab. & Clin. Med.*, 1931, 16, 593). Smears from throat cultures are flooded with Gram's iodine for 1 minute; rinse in tap water; stain with Loeffler's methylene blue for 20-30 seconds; rinse and stain with 1 p.c. aqueous safranin for from 10 to 15 seconds, rinse, dry, and mount. There is a very definite contrast of colour between the polar bodies and the body of the organism. The polar bodies are dark bluish-black, while the organism is red; other organisms stain red, Gram positive cocci seeming to stain more darkly than other bacteria.

G. M. F.

A New Method of Staining Bang's *Bacillus abortus* in Naturally Infected Material.—I. MATERNOWSKA ("Eine neue Färbungsmethode zum Nachweis der Abortus-Bang Bakterien im natürlichen faulenden Material," *Zentrabl. f. Bakt. I Abt., Orig.*, 1930, 116, 422). This method is of value for showing up the *bacillus*

abortus when decomposition products and other bacteria obscure the picture. Small pieces of well-preserved placenta are well washed to isolate the external foul masses. Smears obtained from this cleansed material almost always contain *B. abortus*. Smears are fixed and 10 p.c. potassium hydroxide is applied for 5 minutes, then a 2 p.c. solution of carbol-thionin for 3-5 minutes is applied, and the sections rinsed and dried. Potassium hydroxide not only loosens the epithelial cells, but intensifies the staining of the organisms.

G. M. F.

Heavy Metals as Fixatives.—A. S. CRAFTS ("Some Experiments with Salts of Heavy Metals as Fixatives," *Stain Technol.*, 1931, 6, 131-48). Heavy metal salts, mostly in 0.5M concentration, were used for tissue fixation and for albumin and gelatin precipitation. Tissues from the dog, cat, and rabbit were stained in acid and basic stains. Precipitation of protein solutions appeared to be influenced by the atomic weight of the cation of the electrolyte; a relatively good protein precipitant is not necessarily a good tissue-hardening agent, though the reverse holds true. Penetration of an electrolyte may be uniform or non-uniform, and in the former condition the resulting shrinkage may be either generalized or cellular, in the latter condition usually both. Tissue hardening is no criterion for evaluation of tissue preservation. Mordants can be classified into isomordants with a similar affinity for both acid and basic dyes, acid mordants with a greater affinity for acid dyes, and basic mordants with a greater affinity for basic dyes.

G. M. F.

Cytology.

Microglia in Birds.—V. BELMONTE VENTO ("Contribución al conocimiento de la microglia en las aves," *Bol. de la Soc. españ. de Hist. nat.*, 1931, 31, 349-60, 6 text-fig.). Puncture of the brain in fowls and pigeons produces a change in the surrounding microglia cells, which become rounded and phagocytic, and exhibit the same structures as in the case of other vertebrates.

G. M. F.

Radiation of the Gametes of the Frog and its Effect on Gastrulation.—A. DALCQ and S. SIMON ("Contribution à l'analyse des fonctions nucléaires dans l'ontogénèse de la grenouille. III. Étude statistique et cytologique des effets d'irradiation d'un des gamètes sur la gastrulation chez *Rana fusca*," *Arch. de Biol.*, 1931, 42, 107-65, 20 text-fig.). An exhaustive account, both statistical and cytological, is given of the effects on the eggs and spermatozoa of the frog resulting from exposures of varying intensity to radium, X-rays, and ultra-violet light.

G. M. F.

Modifications in the Pituitary of the Guinea-Pig as a Result of Pregnancy.—L. DESCLIN and L. BROUHA ("Étude expérimentale des modifications gravidiques de l'hypophyse chez le cobaye," *Arch. de Biol.*, 1931, 42, 167-83, 1 pl.). In guinea-pigs with deciduomas the anterior lobe of the pituitary always has the appearances characteristic of pregnancy. In guinea-pigs in which a state of pseudo-pregnancy has been induced by postœstral hysterectomy the anterior lobe of the pituitary, removed 60 days after the hysterectomy, is identical in appearance with that at the end of normal pregnancy. The reaction in the pituitary is due either to folliculin alone or to a combined action of folliculin and the hormone of the corpus luteum.

G. M. F.

Development without Membrane Formation in the Egg of the Sea Urchin.—A. R. MOORE and M. M. MOORE ("Fertilization and Development without Membrane Formation in the Egg of the Sea Urchin (*Paracentrotus lividus*),"

Arch. de Biol., 1931, 42, 377-88, 8 text-figs.). The eggs of *Paracentrotus lividus* can be fertilized and caused to develop without the formation of membranes if the unfertilized eggs are first treated with a solution of a non-electrolyte such as urea or glycerine. In normal eggs, immediately after fertilization, the fertilization and hyaline membranes can be dissolved by treating the eggs with a solution of a non-electrolyte. Eggs of *Paracentrotus* which develop without membranes form ellipsoidal blastulæ, which invaginate and become slightly abnormal plutei. The fact that the naked eggs form blastulæ is referred to the great contractility of the cell bridges and to the mode of formation of the micromeres which result from division in a horizontal plane. The contractility, and, indeed, the existence of cell bridges, is dependent on the presence of sufficient calcium ion in the medium. *Paracentrotus* shows two types of cell bridges, namely those resulting from cell division, called primary, and fine strands which appear first in the four-cell stage, and may be seen to be thrown out from the blastomeres into the surrounding fluid. These are called secondary cell bridges. G. M. F.

Rieder's Cells in the Blood of Syphilitics.—A. ESTRADA ("Les cellules de Rieder dans le sang des syphilitiques," *Compt. rend. Soc. de Biol.*, 1929, 102, 251-2). Rieder's cells are true monocytes, and only differ from other mononuclear cells present in the blood by the lobulation of the nucleus, which may be divided into two, three, or four lobes, in the form of an S or T. In the blood of syphilitics such cells are constantly present, but they are not specific since they have been found in various forms of leukæmia. G. M. F.

Meiosis.—C. D. DARLINGTON (*Biol. Rev.*, 1931, 6, 221-64, 8 text-figs.). This important review of meiosis has for its aim the demonstration that a uniformity of principle underlies the external diversity of meiosis. This diversity is due to the occurrence of differences in detail, which for the most part have some mechanical, and hence genetic, significance. Such differences do not affect the universal principles on which hereditary mechanism works, but rather provide critical tests of their validity. Meiosis is regarded as having originated as an abnormality of mitosis in a diploid (zygote) nucleus, in which prophase contraction has anticipated the division of each chromosome into two threads. Meiosis is the chief source of genetic variation by changes in proportion, and the only means by which genetic variations are redistributed. Crossing-over can take place when chromosomes in close contact divide. Pairing leads to occasional entanglement of non-homologous chromosomes. These, therefore, are in a condition to cross over and give structural changes or "mutations." An extensive bibliography is appended. G. M. F.

Epithelial Cells Derived from Fibroblasts of the Chick Embryo Heart Cultured in vitro.—H. GROSSFELD ("Production *in vitro* d'un épithélium aux dépens des fibroblastes du cœur d'embryon de poule," *Compt. rend. Soc. de Biol.*, 1931, 108, 747-50, 2 text-figs.). Chick fibroblasts cultured in a mixture of equal parts of chick embryo extract and a hypotonic solution consisting of NaCl 0.54, KCl 0.0257, CaCl₂ 0.015, distilled 100 parts, grow out in the form of what morphologically resemble epithelial cells. G. M. F.

Reaction of Cells to Tubercular Infection in Tissue Culture.—E. M. WERNEL ("Reaktion der Zellen auf Tuberkelinfektion in den Gewebeskulturen," *Virchow's Arch. f. Path. Anat. v. Physiol.*, 1931, 281, 297-315, 13 text-figs.). Tissue cultures of the guinea-pig's spleen were infected with the BCG strain of tubercle bacilli. Bacilli were phagocytosed by histiocytes and polymorphonuclear leucocytes. Epithelioid cells are regarded as merely modified macrophages. G. M. F.

The Combined Influence of Heat and X-rays on Cellular Division in Tissues Cultivated *in vitro*.—K. TAGE and J. JENS ("Influence combinée de la chaleur et des rayons X sur la division cellulaire dans des tissus cultivés *in vitro*," *Compt. rend. Soc. de Biol.*, 1931, 108, 144-5). Heating tissue cultures of chick embryo fibroblasts at 50° C. for 20 minutes produces an irreversible change in the cytoplasm and the cells die. When the exposure is less prolonged, the process is reversible; the cells survive and can again divide. Heating for 5 minutes at 47-48° C. also produces a reversible change. Heating at 45-46° C. allows the cells to begin mitosis, but the change of protoplasm from sol to gel is retarded, and hence the polar migration of the chromosomes. Heating at 44° C. produces no result.

G. M. F.

Application of the Method of Del Rio Hortega for the Coloration of Epithelial Fibrils and the Muci-Carmine Method for the Differentiation of Adenomatous Forms of the Epithelioma of the Neck of the Uterus.—L. CUILERA ("Application de la méthode de Del Rio Hortega pour la coloration des fibrilles épithéliales et du muci-carmin, à la différenciation des formes adénomateuses de l'épithélioma du col utérin," *Compt. rend. Soc. de Biol.*, 1931, 108, 173-4). Application of the two methods successfully differentiates between epithelial and glandular cells.

G. M. F.

Investigations on the Structure of the Pituitary. Epidermal and Glandular Inclusions.—M. PÉREZ LISTA ("Investigaciones acerca de la fina estructura de la hipófisis. I. Gérmenes epidérmicos y heteroglandulares," *Bol. de la Soc. españ. de Hist. nat.*, 1931, 31, 409-24, 9 text-figs.). The occurrence of masses of epidermal cells and of cells resembling those of the salivary glands, embedded in the pituitary gland, has been known for some time. The various impregnation methods of Río-Hortega were here applied to serial sections of the pituitary glands. The grade of differentiation of the epidermal inclusions is not always the same; sometimes the cells have definite intercellular bridges with well-marked fibrillae, at other times they resemble cells of the basal layers of the epidermis, or they approximate to the glandular formations of the anterior lobe with which they are intimately mixed. The importance of these cellular inclusions in the formation of blastomas is stressed.

G. M. F.

The Characteristics of the Retinal Microglia which has Emigrated into the Vitreous Humor.—M. LÓPEZ ENRIQUEZ and I. COSTERO ("Sobre los caracteres de la microglia retiniana emigrada al humor vitreo," *Bol. de la Soc. españ. de Hist. nat.*, 1931, 31, 425-31, 4 text-figs.). In a case of glaucoma, which as the result of a surgical intervention had developed into a chronic iridocyclitis, there were found in the vitreous humour microglia cells, some with dendrites, others without dendrites. In certain of the adendritic cells the pseudopodial processes characteristic of pathological microglia cells were seen, but without phagocytic activities. The typical microglia cell with ramifications was flattened so as to lie in one plane, and the processes were furnished with curious swellings. These swellings are found in microglia cultivated *in vitro*, and are an artefact due to the action of dilute formol.

G. M. F.

Nuclear Changes Produced by Staphylococcal Toxin.—L. DE WALSCHÉ ("Recherches sur les ondes de mitoses et de pycnoses provoquées par la toxine staphylococcique," *Arch. de Biol.*, 1931, 42, 185-200). A microbial toxin injected in non-fatal doses produces in the lymphopoietic organs waves of mitosis and pyknosis. These waves are specific for each organ and each toxin. Organs like the

liver, which in the adult state do not exhibit mitoses, show numerous mitotic figures following an injection of staphylococcal toxin. Thymocytes and lymphocytes react in a different way to staphylococcal toxin; in lymphoid organs the peak in the number of pyknotic nuclei precedes the peak in the number of mitotic figures. In the thymus the reverse is the case. G. M. F.

The Graafian Follicles of the Ovary in the Rabbit.—A. L. SALAZAR ("Période post-chromatolytique de l'atrésie des follicules de De Graaf: atrésie des follicules jeunes et primordiaux de l'ovaire de la lapine," *Compt. rend. Soc. de Biol.*, 1931, 106, 1182-3). Small, primordial, Graafian follicles are said to undergo a special form of atresia, which is extremely rapid. The nuclei lose their outlines and the chromatin becomes diffuent, while the interstitial tissue shows no reaction. G. M. F.

The Histology of the Rabbit's Ovary Studied by the Iron Tannate Method.—A. L. SALAZAR ("Quelques points de l'histologie de l'ovaire de la lapine étudiés par la méthode tanno ferrique," *Travaux de l'Inst. d'Hist. et d'Embryol.*, 1931, 2, 219-380, 31 pls.). In this monograph on the ovary of the rabbit the Graafian follicle and the interstitial tissue receive special notice. G. M. F.

Somatic Elimination of a Chromosome in *Drosophila melanogaster*.—O. L. MOHR ("Cytological Proof of Somatic Elimination of a Chromosome in *Drosophila melanogaster*," *Arch. de Biol.*, 1931, 42, 365-73, 1 text-fig.). Complete proof is here given of somatic elimination of a chromosome and of mosaicism in *Drosophila melanogaster*, based not only on external inspection of the mosaic produced, but on full breeding tests and on cytological evidence. For some of the earlier supposed "diminished" mosaics it is difficult to exclude the possibility that they may be due to somatic mutation to a dominant gene in one of the early cleavage cells. This source of error is here excluded. G. M. F.

Mitochondria and Proteolytic Ferments. An Examination of the Hypothesis of Robertson and Marston.—E. LE BRETON ("Mitochondries et ferments protéolytiques. Examen de l'hypothèse de Robertson-Marston," *Arch. de Biol.*, 1931, 42, 349-63). Marston has suggested that proteolytic enzymes accumulate at the surfaces of mitochondria, and in favour of this hypothesis has shown that pepsin and trypsin in an alkaline medium are precipitated by azines. It is here shown that sodium and potassium phosphates, nucleic acid, histone, peptone, gelatine, casein, and serum globulin are also precipitated by azines. On the other hand, certain tryptic ferments, such as proteinase and carboxypolypeptidase, purified by Willstalter's methods, are also precipitated by azines. G. M. F.

The Genesis of the Blood in Amphibians.—P. SLONIMSKI ("Recherches expérimentales sur la genèse du sang chez les amphibiens," *Arch. de Biol.*, 1931, 42, 415-77, 3 pls., and 19 text-figs.). The development of the red cells in axolotls and frogs was studied. By removal of certain portions of the embryos it was possible to show that in amphibians there is a blood-forming area (zone sanguine présumptive) removal of which prevents the appearance of any red blood corpuscles. This area possesses the capacity of strict auto-differentiation, and is probably differentiated at a very early stage (gastrula). G. M. F.

Experimental Observations on the Mode of Segmentation of Lamelli-branch Molluscs. The Action of Ultra-violet Rays on the Egg of *Barnea candida*.—J. PASTEELS ("Recherches sur le déterminisme du mode de segmenta-

tion des mollusques lamellibranches. Action des rayons ultra-violet sur l'œuf de *Barnea candida*," *Arch. de Biol.*, 1931, **42**, 389-413, 6 text-figs.). The reasons for the inequality of the mitotic divisions occurring during the segmentation of molluscs and annelids are at present unknown. Experimental evidence is here brought forward to suggest that the inequality in segmentation is due to a difference in permeability. Ultra-violet rays and magnesium chloride equalize the mitoses by equalizing the permeability of the egg, for while ultra-violet light decreases permeability, magnesium chloride increases it. G. M. F.

The Formation of Twins in Fresh-Water Snails.—E. D. CRABB ("The Origin of Independent and of Conjoined Twins in Fresh-Water Snails," *Wilhelm Roux' Arch. f. Entwicklungsmechanik der Organismen*, 1931, **124**, 332-56, 14 text-figs.). The observations here described fail to support the idea of possible monozygotic origin of any two or more of the two to forty-six separate or any of the conjoined vitelli or embryos which have been found or produced by the author in single fresh-water snail eggs. Migratory movements of the vitelli in a twin egg are figured from first cleavage intermittently to complete fusion and cytolysis. In cases in which any of the developmental history of conjoined twins, triplets, and quadruplets is known, it is evident that the monster has arisen from two, three, or four vitelli. Sixteen normal adults of *Lymnæa stagnalis appressa* were obtained from four eggs, each containing four vitelli. There is no indication that polyvitellinity is an hereditary character. Separation of the primary blastomeres may result in continued, though abnormal, development of one or both blastomeres till early death. Very slight injury to one of the primary blastomeres resulted in abnormal cleavage and death of the embryo. Injury to any one or two blastomeres of the four-cell stage apparently causes death without further cleavage. None of the non-experimental, experimental, conjoined, or other monsters or injured vitelli developed to the hatching stage. The chances of monozygotic twinning occurring in *Lymnæa stagnalis appressa*, *L. palustris*, and *Physa gyrina* are very nearly if not quite nil. G. M. F.

Induced Division of Golgi Bodies.—J. BRONTË GATENBY ("Induced Multiplication and Growth of Golgi Bodies and Alteration of Nebenkern Pattern and Nucleolus in *Abraxas grossulariata* Spermatogenesis," *Journ. Exp. Zool.*, 1931, **60**, 285-308, 3 pls.). The Golgi bodies of moths are shown to be osmiophilic platelets with chromophile edge and chromophobe centre. Division of the Golgi apparatus may be produced by heating to 30° C. and the injection of phosphorized olive oil. The pattern of the spermatid mitochondrial nebenkern is definitely altered by the injection of phosphorized olive oil into *Abraxas* larvæ, and a variety of types, coarse and fine, are formed probably by the formation of mitochondrial tubes which fuse to form a coarser pattern than usual. The nucleoli also change in larvæ injected with phosphorized olive oil and incubated for 18 hours at 37° C. from irregular blocks to spherical or ovoid droplets, which persist through maturation divisions, and are carried whole into one of the four spermatids. G. M. F.

Sex Transformation in Parabiotic Amblystoma.—R. K. BURNS ("The Process of Sex Transformation in Parabiotic Amblystoma," *Journ. Exp. Zool.*, 1931, **60**, 339-86, 7 pls., and 7 text-figs.). In parabiotic pairs of *Amblystoma tigrinum* Green which differentiate early, sex differentiation is at first primary or according to zygotic determination. Later members of male-female combinations exhibit a transformation of sex from female to male or male to female. In the majority of cases the male partner becomes dominant, and a reversal of the female-male type ensues. The male to female type of transformation is dependent on a

bisexual composition of the embryonic or larval testis, in which a differentiated female component exists in the form of male cortex. The transformation process consists essentially in a hypertrophic development of the male cortex, in which the germ elements assume the cytological characteristics of ovocytes, accompanied by regressive changes in the medulla—degeneration, vacuolization, excavation. A condition closely simulating normal, but retarded, ovarian development is readily attained.

G. M. F.

Histology.

The Tear Gland of an Antelope.—R. CORDIER ("La glande du larmier d'*Oreotragus saltator*," *Arch. de Biol.*, 1931, 42, 59–69, 1 pl.). The tear gland of the African antelope, *Oreotragus saltator*, consists of three portions, a sebaceous portion, a sweat gland portion, and what is termed a hepatoid portion. Many of the cells of this last portion contain melanin pigment.

G. M. F.

Experimental Liver Cirrhosis Produced by Thorium Oxide.—R. HUGUENIN, A. NEMOURS, and G. ALBOT ("Les hépatites et les cirrhoses expérimentales au bioxyde de Thorium," *Compt. rend. Soc. de Biol.*, 1931, 108, 879–81). The intravenous injection of a stabilized colloidal suspension of thorium into rabbits produces a form of cirrhosis of the liver.

G. M. F.

Cirrhosis by Salts of Cobalt.—M. VILLARET, I. BERTRAND, L. JUSTIN-BESANÇON, and R. EVEN ("Les cirrhoses cobaltiques," *Compt. rend. Soc. de Biol.*, 1931, 108, 956–7). 2 c.cm. of an 0.5 p.c. solution of cobalt acetate injected into rabbits and guinea-pigs causes a liver cirrhosis.

G. M. F.

Arthropoda.

Insecta.

New Staphylinidæ.—M. BERNHAUER and H. SCOTT ("Entomological Expedition to Abyssinia, 1926–7—*Coleoptera*, *Staphylinidæ*," *Journ. Linnean Soc., London*, 1921, 37, no. 255, 559–606). The *Staphylinidæ* under review were collected by Dr. Hugh Scott and Mr. J. Omer-Cooper, during their expedition to Abyssinia from August, 1926, to February, 1927. 123 species, representing 43 genera, are enumerated, and many others have been left undetermined owing to inadequacy of material. 56 species (representing 23 genera) are described as new, and one new genus is erected, while 56 out of the 67 previously known species are here for the first time recorded from Abyssinia. In a work entitled "*Zur Staphylinidin—Fauna des Tropischen Afrika*" (1915), Dr. Bernhauer described 42 species from Abyssinia, only 7 of which were rediscovered by the present expedition. Thus in that article (*Ann. Mus. Nat. Hungar.*, 1915, 13, 95–189) and the present report together 158 species are described or recorded from Abyssinia, while many other descriptions and records have appeared in scattered papers by Dr. Bernhauer and other writers. The number of species of *Staphylinidæ* in a country so vast, so diversified in topography, altitude, climate, and vegetation, may easily, it is thought, run into many thousands—especially since in the British Isles alone there are nearly 900 species.

M. E. M.

Mandibular Growth in Stag-Beetles.—J. S. HUXLEY ("Relative Growth of Mandibles in Stag-Beetles (*Lucanidæ*)," *Journ. Linnean Soc., London*, 1931, 37, no. 255, 675–703, 9 graphs). The following is taken from the author's summary. Linear measurements of length of mandibles and body (or elytron) made by H. H.

Brindley, the author, and E. Dudich, respectively, in the males of three species of *Lucanidae*, have been analysed. It is shown that the simple heterogony formula $y = bx^k$, where y = mandible length, x = "total" length (mandible length + body length), and b and K are constants, provides the basis for an expansion of mandible growth. The values of K are, for *L. cervus* about 2.3, for *L. lunifer* about 1.55, for *Cyclommatus tarandus* 1.97. The approximation of actual to expected figures is close for the smaller individuals of each species. In all cases the curves bend over in the high parts of their range, the actual mandible size falling progressively more and more below expectation. This, it is suggested, may be accounted for owing to the limited amount of food material in the pupa being exhausted before the very large mandibles can be formed. In holometabolous insects, such as the *Lucanidae*, it is assumed that the heterogonic relation between mandible and rest of body is produced in one of two ways—either by the formation of a substance responsible for the heterogonic growth of the mandible rudiment continuously throughout larval growth at a heterogonic rate, or by the sudden appearance of heterogonic growth in the rudiments of the imaginal mandibles at a definite stage during the pupal stage. Experiments on larval nutrition are needed to decide this point. As a result of these facts, it is concluded that the "forms" of male *Lucanids* distinguished by coleopterists are purely growth forms, and have no systematic significance. A tendency for multi-modality is evident in the frequency curve for the mandibles of male *Cyclommatus tarandus*; this appears to be correlated with the greater range of body size in this species, and consequent presumed greater variability of moult number as compared with the other *Lucanids* studied. D'Arcy Thompson and Przibram's theory, which sees the cause of bi-(multi-)modality of heterogonic organs in a variation in moult number during larval life, is extended to make it fit the facts, and is further generalized.

M. E. M.

Morphology of the Insect Abdomen.—R. E. SNODGRASS ("Morphology of the Insect Abdomen. Part I. General Structure of the Abdomen and its Appendages," *Smithsonian Miscellaneous Collections*, 1931, 85, no. 6, 1-128, 46 text-figs. Publication No. 3124). The title of this work is sufficiently descriptive of its subject-matter.

M. E. M.

Notes on Australian Diptera.—J. R. MALLOCH ("Notes on Australian Diptera, XXVIII," *Proc. Linnean Soc., N.S.W.*, 1931, 56, pt. 4, no. 236, 273-6). Some data are presented upon the family *Rhogionidae* which it is hoped will prove of interest to students of geographical distribution, as well as to those who are more directly and exclusively interested in the family systematically. Descriptions are given of 5 genera and 2 species. Also an identification key to 6 genera.

M. E. M.

Notes on Australian Diptera.—J. R. MALLOCH ("Notes on Australian Diptera, XXIX," *Proc. Linnean Soc., N.S.W.*, 1931, 56, no. 236, pt. 4, 292-8, 2 text-figs.). The present paper is a résumé of our knowledge of the Australian members of the family *Piophilidae*, with descriptions of a new species, of a very striking new genus and species of *Helomyzidae*, and some data on certain genera of *Tachinidae*, with descriptions of two species of the genus *Palpostoma* Robineau-Desvoidy. The recorded occurrence of the genus *Catharosia* Rondani is also dealt with on the basis of the material upon which it was included in the Australian list.

M. E. M.

Australian Lepidoptera.—A. J. TURNER ("Revision of the Australian *Lepidoptera* (Supplementary)," *Proc. Linnean Soc., N.S.W.*, 1931, 56, no. 236, pt. 4,

325-44). This instalment consists of corrections and additions to the families previously treated in this revision, together with some new species belonging to groups which the author has revised at earlier dates. M. E. M.

Wing Variation of Isoptera.—R. J. TILLYARD ("Wing Variation of the Order *Isoptera*. I. Introduction and the Family *Mastotermitidae*," *Proc. Linnean Soc., N.S.W.*, 1931, 56, no. 236, pt. 4, 371-90, 8 text-figs.). The total number of described species of termites in the whole world is now about 1600. Of these, already about 150 have been described from Australia, while an additional seventy are known but not yet named and described. So inadequate have been many of the descriptions and definitions that the position at the present time is such that it appears almost impossible to determine what some of the economic forms really are. The author and Mr. G. F. Hill have decided, in view of the accumulation of a large mass of material, to carry out joint research with a view to the publication of a series of papers correlating their results. The author's share of this work will consist of four parts, based on the four recognized families within the order, viz. *Mastotermitidae*, *Calotermitidae*, *Rhinotermitidae*, and *Termitidae*. The present part deals with the family *Rhinotermitidae*. M. E. M.

Ichneumonidae from Kamtchatka.—A. ROMAN ("Entomologische Ergebnisse der schwedischen Kamtchatka-Expedition, 1920-22, 33, *Ichneumonidae*, Subfamilien *Pimplinae* und *Tryphoninae*," *Arkiv. för Zoologi*, Bd. 23, häfte 1, 1931). Notes and descriptions are given on 123 species. M. E. M.

Aphid Genetics.—A. F. SHULL ("Order of Embryonic Segregation in Intermediate Aphids not Reversed by Low Temperature," *Amer. Nat.*, 1931, 65, 469-73). This paper is devoted to the consideration of the possible explanation underlying the composition of intermediates between gamic and parthenogenetic aphids. The author discusses Goldschmidt's theory, and states that the results of his earlier work have not given results in agreement with this theory. Three alternative hypotheses are advanced, and the probable validity of each is considered, it being concluded from the results of the author's experiments that the second hypothesis must be ruled out. It is hoped that the more complete study of intermediates which is in progress will throw light on the relative values of the remaining two. M. E. M.

The Aphididae of Illinois.—F. C. HOTTES and T. H. FRISON ("The Plant Lice, or Aphididae of Illinois," *State of Illinois Department of Registration & Education, Division of the Natural History Survey*, 1931, 19, art. iii, 122-447, 10 pls., 50 text-figs.). This large work is stated by its author to be purely faunistic or synoptic in scope, and that it is not to be considered as a revisional or monographic contribution. In May, 1928, the Natural History Survey started a faunistic study of the plant lice occurring in Illinois, with the intention of providing information concerning the number of kinds found in the state, their characteristics, distribution, host relationship, seasonal adjustments, importance as potential enemies, and a general concept of their life-histories. To meet this aim it was necessary at the outset to plan a systematic inventory of the plant lice fauna of the state. Accordingly, a study was made of all the published Illinois records of these insects, and the possibilities of extending this list, based upon a knowledge of the flora of Illinois and of the plant lice recorded elsewhere, were considered. Over 12,000 miles were traversed by automobile in conducting the field work, and the general routes followed are indicated by means of a map. The field investigations were made during the

three summers 1928-30, beginning in May each year. The identification keys presented in this work are prepared almost entirely on the basis of the alate viviparous females, since these forms are usually taken in the field, and since they usually present a better combination of characters for recognition than do the other forms. The keys are not intended to show phylogenetic relationships, even if at times they may do so; but are primarily devised to make identifications as easy and simple as possible. Excellent photographs are embodied in this contribution, showing the different species of plant lice upon their host plants. M. E. M.

Biological Control of the Pink Mealy Bug.—F. C. HADDEN ("Efforts towards Biological Control of the Common Pink Mealy Bug, *Trionymus sacchari* (Cockerell), of Sugar Cane on Negros," *Philippine Journ. Sci.*, 1931, 46, no. 2, 221-3). The effect of the dry season is to inhibit the growth of the entomophagous fungus *Aspergillus* sp., which is of considerable importance to the natural control of the mealy bug. The damage caused by mealy bugs to the cane of Negros is considerable. In order to try to decrease the number of mealy bugs now in evidence and to try to provide insurance against any possible future outbreak of the pest, two kinds of natural enemies (from Laguna, Luzon) have been liberated in parts of Negros by the Entomology Department, Philippine Sugar Association. One of the insects is *Scymnus* sp. (gen. *Pullus*?)—order *Coleoptera*, family *Coccinellidae*—a small brown lady-bird measuring 1.5 millimetres in length. The fully grown larvæ are only 3 millimetres in length, their small size enabling them to get down between the leaf-sheath and stalk where the mealy bug is most commonly found. They devour the young mealy bugs, and are thus predators. The second natural enemy that has been tried is a small wasp *Anagyrus* sp. (family *Encyrtidae*). This species of wasp lives as a parasite of the ova, larvæ, or pupæ of various insects. Its eggs are laid in the nearly mature or fully mature mealy bugs. Up to December, 1930, colonies ranging in number from 40 to 100 individuals of each species have been liberated at the La Carlota Central Experiment Station field, and at six other situations. These fields will not be harvested before January, 1931, it is stated, thus allowing the natural enemies sufficient time to become established.

M. E. M.

Philippine Tipulidæ.—C. P. ALEXANDER ("New or Little Known *Tipulidæ* from the Philippines (Diptera), XI," *Philippine Journ. Sci.*, 1931, 46, no. 2, 269-304, 3 pls.). The interesting crane flies herein discussed were taken in various parts of Luzon by the author's friends, Messrs. McGregor, Duyag, and Rivera; and in Minadano by his former student at Amherst College, Mr. Charles F. Clagg. A large number of genera and species are dealt with, and keys are provided for their identification.

M. E. M.

Moths of Eastbourne.—R. ADKIN ("The Moths of Eastbourne. Part II. *Pyrallidina*, *Tineina*, *Nepticulina*, and *Micropterygina* (including the *Burnets*, *Clearwings*, *Swifts*, etc.)," *Transactions of the Eastbourne Natural History, Photographic, and Literary Society*, 1931, 10, 2nd suppl., 1-98 (excluding index), 25 pls., and map of the district). The six Phyla or super-families dealt with in this part are represented in Britain by some 1328 species; of these just over 500 have been recorded as having occurred within the Eastbourne area. This, when compared with the relative numbers shown in the Butterflies and the Moths dealt with in Part I, makes but a poor showing, and suggests that the district has not been very thoroughly investigated. If confirmation be needed, it may be found in the fact that during the short period in which this work has been in preparation, one or two local friends of the author and himself have, without special effort, met with some score

of species not previously known to occur in the district. The author, therefore, urges further attention by entomologists to the moths of the district. The work is divided into two sections—the introduction and the systematic section. Under the former, the arrangement followed is outlined, the district and its features are described, notes on rearing larvæ are provided, as well as notes on the setting the moths.

M. E. M.

Arachnida.

Australian Acarina.—In 1922 Haswell recorded, under the name of *Astacocroton molle*, a new mite, the female of which is parasitic on the gills of *Astacopsis serratus*, the spiny crayfish of the rivers of Eastern Australia. The description did not contain the data essential for systematic purposes, and to fill this gap Viets has now redescribed the imago of the male and female (Zool. Anz., 1931, 97, 85–93, figs. 1–9). At present the nymphal and larval forms are unknown. One of the localities named is Bateman's Bay, N.S.W. (State Trawling Dept. Coll., 1903), but there is no indication as to the capture being made in fresh water running into the bay or in brackish water. Victoria is now included in the distribution area hitherto restricted to New South Wales. Included among the material sent as *A. molle*, but taken in S. Queensland, were some which proved to be not hydracarids, but halacarids, also parasitic on *Astacopsis serratus*. Viets has described these as *Astacopsiphagus parasiticus* nov. gen., nov. sp., with new sub-family *Astacopsiphaginae* (Zool. Anz., 1931, 96, 115–20, figs. 1–6).

B. M./H. N. D. H.

The Order Chelonethida (Arach.).—J. C. CHAMBERLIN ("The Arachnid Order Chelonethida," *Stanford University Publication, University Series, Biological Sciences*, 1931, 7, no. 1, 1–279, 71 text-figs.). This contribution attempts to present in adequately illustrated form an exposition of our present knowledge of the comparative external anatomy of the Arachnid order Chelonethida (*Pseudoscorpionida*), and, based upon this, a consideration of the systematics of the order. In addition to attempting the unification of the existing knowledge of the morphology of the group, it presents the data independently derived by the author from several years of intensive study. As a result of this work, the systematics of the order are here completely reorganized, almost nothing remaining of the various classifications that have previously been proposed. The paper thus naturally falls into two major parts: one in which the basic morphological data are presented, and a second in which these data are utilized in the development of a classification.

M. E. M.

Rotifera.

New Rotifers from South Africa.—G. EVELYN HUTCHINSON (Yale) ("New and Little-Known Rotatoria from South Africa," *Ann. Mag. Nat. Hist.*, Ser. 10, 1931, 7, 561–8, 4 text-figs.) describes two new species, *Monostyla stephensæ* from Portuguese East Africa and *Keratella tetracera* from the Transvaal and from East Cape Province. The latter is a particularly interesting form, and might be said to be a new departure in the genus *Keratella*. It differs from its hitherto known congeners in three striking and important characteristics, viz. in having only four anterior dorsal spines on its lorica in place of the customary six, in the outer pair of these spines being very much longer (four times) than the inner, which are usually the longer, and in the tessellation of the dorsal surface of the lorica being of a distinctly different design from that of any of these congeners, and being, moreover, carried over on to the ventral plate. This species has fortunately been met with in quite a number of localities in each of the territories named, but it would be

premature to regard it as endemic to South Africa. It occurs both in fresh and in alkaline waters. The author has, further, given specific rank to the form described by de Beauchamp as the variety *chattoni* of *Rattulus cylindricus* (Imhof), but transferred, along with all other species of *Rattulus*, by Haring in 1913 to the older genus *Trichocerca* Lamarck. Specimens have occurred in two artificial lakes in the Transvaal, and their examination appears to justify the change made. The correct name of this very rare form is accordingly *Trichocerca chattoni* (de Beauchamp).
D. L. B.

Protozoa.

Micronuclear Variation.—L. L. WOODRUFF ("Micronuclear Variation in *Paramaecium bursaria*," *Quart. Journ. Micr. Sci.*, 1931, 74, 537-45, 1 text-fig.). A study on the variation of the number of micronuclei in a pedigree race of *Paramaecium bursaria*, which normally possesses one micronucleus. Individuals with two micronuclei were isolated, and the strain was maintained in mass cultures or in daily isolation cultures (hay-infusion) for seven years. The bimicronucleate state persisted for fifty generations. Later on, after several months, unimicronucleate ciliates appeared, and gradually all the bimicronucleate lines became unimicronucleate, in about one year after observations were commenced. During this period variation in the micronuclear number ranged from one to four. The typical culture of *P. bursaria* was carried on in mass cultures for more than four years without special attention. Isolation cultures were then started from two mass cultures. In one the ciliates had a single micronucleus, refractory to chromatin stains. In another culture the animals had become amicronucleate. Neither endomixis nor conjugation has ever been observed during the seven-year period of culture, and the cultures remained in a flourishing condition up to the time of writing. These observations emphasize the necessity of a long study of pedigree cultures to make certain that such characters like micronuclear number are of specific value. The variation in the micronuclear number may be due to precocious division or irregular distribution of micronuclei during cell division. C. A. H.

The Parabasal of Flagellates.—O. DUBOSCQ and P. GRASSÉ ("L'appareil parabasal et les constituants cytoplasmiques des zoo-flagellés," *C. R. Acad. Sci.*, 1931, 193, 604-5). This is a brief summary account of the nature of the parabasal apparatus in the Mastigophora, and its relation to other cytoplasmic structures. The following organellæ have been found in the flagellates: the mucus producing apparatus, food, and contractile vacuoles, pustules, "cinétovacuaes," and the vacuome. Mitochondria present in all flagellates are not related to the parabasal. The parabasal is usually connected with the blepharoplast, but may become detached during division. As a rule, it multiplies by binary division, but the possibility of its being formed *de novo* is not excluded. It has been shown to behave like a gland, secreting globules during division. The authors believe that the parabasal is homologous to the idiosome of the sexual cells in Metazoa, and consequently represents the Golgi apparatus.
C. A. H.

The Structure of Textularia.—E. LACROIX ("Microtexture du test des Textularidæ," *Bull. de l'Inst. Ocean.*, 1931, no. 582, 1-18, 10 text-figs.). The Textularidæ are not "perforate," but "chitino-arenaceous" foraminifera. The term "perforations" in the sense used for the hyaline foraminifera is therefore incorrect, and should be abandoned. The sandy covering is merely traversed by a system of canals which open on the surface of the shell by a series of microscopic "pores," and such a structure should be described as "porous." This structure is

probably constant in all the larger species of *Textularia*. These canals and pores form the medium by which the protoplasm communicates with the surrounding sea water, by dialysis through the chitinous membrane of the test; they probably serve not only for the entrance of nutriment, but also for the disposal of excretions. In the smaller species a similar role may be filled by the minute gaps between the sand grains forming the test, which are imbedded in the chitinous membrane.

A. E.

The Specific Characters of *Endothyra baileyi* (Hall).—LLOYD G. HENBEST ("The Species *Endothyra baileyi* (Hall)," *Cont. Cush. Lab. For. Res.*, 1931, no. 115, 90-3, figs. 14-31 on pl. 11). *Endothyra* occupies a position of unusual interest among Palæozoic foraminifera as a possible ancestor of the Fusulinidæ and kindred forms. *E. baileyi* is most abundant in the Spergen limestone of Indiana, which is largely composed of its shells. Their numbers give the rock an oolitic appearance, but the limestone is not well indurated, and shows very little evidence of secondary mineralization or change of composition. The specimens are about twice the size of the British species *E. bowmani* (Phillips), with which it has generally been regarded as synonymous, and on this fact, coupled with a detailed study of its minute structure, the author concludes that *E. baileyi* should be regarded as a separate and valid species.

A. E.

Hasteriginella.—J. A. CUSHMAN ("*Hasteriginella* and Other Interesting Foraminifera from the Upper Cretaceous of Texas," *Cont. Cush. Lab. For. Res.*, 1931, no. 114, 83-90, figs. 1-13 on pl. 11). The genus *Hasteriginella* was discovered by Rhumbler in recent material from the Atlantic, and has since been recorded from various American tertiary deposits. The author now records the genus from the lower portion of the Gulf Series, and has traced the development of the more primitive species from *Globigerina* or *Globigerinella*. Commencing with the simpler species, in the Austin chalk two species of very advanced form are developed, corresponding rather closely to eocene forms. These were all probably pelagic, and some show traces of having been spinose when living. Three new species are described and figured, viz. *Hasteriginella moremani*, *H. watersi*, and *H. alexanderi*, the latter representing the highest development of the genus in the Cretaceous. Among other interesting discoveries in the Austin chalk are *Hanikenina multispinata*, already known from the Upper Cretaceous of Canada, and *Bathysiphon taurinensis*, previously known as a European fossil.

A. E.

Eocene of Jamaica.—J. A. CUSHMAN and P. W. JARVIS ("Some New Eocene Foraminifera from Jamaica," *Cont. Cush. Lab. For. Res.*, 1931, no. 111, 75-8, figs. 1-6 on pl. 10). Describes and figures four new species from indurated clay in the yellow limestone which seems to be of Middle Eocene Age. They belong to the genera *Haplostiche*, *Quinqueloculina*, *Vertebralina*, and *Eponides*. *Q. jamaicensis* and *V. jamaicensis* are both characterized by ornaments of shallow pits arranged in oblique lines, and bear some resemblance to species already described from the middle eocene of France.

A. E.

New Genera.—J. A. CUSHMAN ("Two New Foraminiferal Genera from the South Pacific," *Cont. Cush. Lab. For. Res.*, 1931, no. 112, 78-82, figs. 7-12 on pl. 10). *Ozawaia*, named after the late Prof. Yoshiaki Ozawa, is a development from *Elphidium* in which the usual nautiloid spiral finishes with a few straight chambers. The type is from the Tonga Islands in 18 fathoms, but a similar form was figured by Millett from the Malay Archipelago as a variety of *Polystomella crispa* (Linné), and the genus may be widely distributed in the Indo-Pacific region. *Ungulatella*

from shallow water off the island of Rangiroa in the South Pacific, is a more distinctive form; the earlier chambers appear to be coiled spirally, later chambers uniserial, forming a sub-cylindrical test compressed towards the apertural end, which is flattened, somewhat concave, and furnished with a comma-shaped opening. It is apparently a uniserial development of *Buliminella*. A. E.

Atlantic Foraminifera.—J. A. CUSHMAN and FRANCES L. PARKER ("Recent Foraminifera from the Atlantic Coast of South America," *Proc. U.S. Nat. Mus.*, 1931, no. 2903, 1-24, pls. 1-4). The material was collected by Dr. Waldo L. Schmitt, and consists entirely of shallow-water samples, maximum depth 15 fathoms. The samples fall naturally into two distinct areas, those taken off the Brazilian coast, where the fauna is essentially West Indian, and those taken farther south, off Argentina and the Falkland Islands, where the fauna is a cold-water one not closely related to that of Brazil. Both faunas have already been dealt with by d'Orbigny in 1839, and many of his species are again recorded by the present authors, who also describe two new species and a new variety. The plates are good. A. E.

Cretaceous of Texas.—HELEN J. PLUMMER ("Some Cretaceous Foraminifera in Texas," *Univ. Texas, Bull.* 3101, 1931, 109-203, pls. 8-15, map). This is an admirable attempt to fix and identify for future reference the published types of Texas cretaceous foraminifera, and includes much original work done by the author in the course of verifying the records of earlier workers, notably Carsey, whose paper on "Foraminifera of the Cretaceous of Central Texas," *Univ. Texas, Bull.* 2612, 1926, was the first attempt of importance to describe the fossils of these strata. The Carsey collection of types, which had become seriously impaired, has been reconstituted, with the co-operation of the original collector. There is a good deal of information respecting the globular bodies which give the popular name of "Orbulina rock" to the limestone of Central Texas. They are rather smaller than the well-known "spheres" of the English chalk, and their nature is equally problematical. They are certainly not the tests of *Orbulina*, and are probably of inorganic and oolitic origin. It is suggested that they may have been formed by the chemical precipitation of calcium carbonate on the surface of bubbles of hydrogen sulphide, or other gas, held in suspension in the colloidal ooze. The systematic part of the paper includes a new genus *Dorothia*, allied to *Gaudryina*, and thirteen new species, and is conspicuous among recent publications for its careful and critical observations. The illustrations are exceptionally good. A. E.

Dispersal of Foraminifera in Eocene Times.—WILLARD BERRY ("Evidence for the Spread of East Indian Forms to Equatorial America during Eocene Time," *Bull. Geol. Soc. Amer.*, 1930, 41, 351-8). Tertiary sediments are known in many localities in the East Indies and Equatorial America, but only those of Java and the West Indies have so far been studied intensively. Details are given of Anthozoa, Arthropoda, and Mollusca, common to both regions. The larger foraminifera are of great value for correlation, and much information is given as to their distribution. Summarizing the facts, the author argues that because of the greater development of new forms in Equatorial America, and the larger number of local faunas, the distribution must have been from the west eastwards across the Pacific, and not *vice versa*, because when a form spreads into a new area it usually evolves more rapidly, giving rise to many and varied species and numerous individuals. Any difficulties in accounting for the spread of a fauna across the Pacific also apply to a spread across the Atlantic westwards. The faunas must have crossed the sea when it was shallow and the climate generally tropical. A. E.

A Peruvian *Nodosaria*.—WILLARD BERRY ("Contributions to the Palæontology of Peru, V. *Nodosaria pozoensis*, W. Berry, n.sp.," *Journ. Washington Acad. Sci.*, 1931, 21, no. 17, 1 fig.). Many disconnected chambers of a species of *Nodosaria* were found in well samples of Eocene Age at Negritos in N.W. Peru. At last a nearly perfect specimen has been found. The organism, which reaches a length of 10 mm., must have lived in deep, still waters, owing to its delicate structure and the fineness of the shale in which the remains are found. It belongs to the group of *Nodosaria raphanus* (Linné).
A. E.

A New *Orthophragmina*.—WILLARD BERRY ("Contributions to the Palæontology of Peru, IV. '*Orthophragmina*' (*Discocyclina*) *meroensis*, W. Berry, n.sp.," *Journ. Washington Acad. Sci.*, 1930, 20, no. 17, 432-3, fig. 1). Describes and figures a vertical section of the new species, which was found in a greenish-brown calcareous sandstone of Saman Conglomerate Age.
A. E.

The *Fusulinidæ*.—WILLARD BERRY ("Distribution of the *Fusulinidæ*," *Pan-American Geologist*, 1931, 56, 181-7, map). The *Fusulinidæ* which formed a dominant group in carboniferous times are found in the northern hemisphere only, with two exceptions. They have been recorded in the Malay Archipelago and in Bolivia, South America. In their period they were almost cosmopolitan in the northern hemisphere. Their distribution must have been governed by climate and environment, also largely by the geography of their time. So palæogeography has a very important part in their study. The author attempts to reconstitute the distribution of the land masses and marine currents of the carboniferous period, in order to account for the wide dispersal of the family in the short period in which it flourished.
A. E.

Peruvian *Lepidocyclinæ*, etc.—WILLARD BERRY ("The Larger Foraminifera of the Atascadero Limestone of North-West Peru, South America," *Eclogæ geol. Helvet.*, 1930, 23, no. 2, 489-96, pls. 14-5). Describes and figures five new species of *Lepidocyclina*, and two new species of *Operculina*, found in limestone at Atascadero in Peru. The rock, which belongs to the Conglomerate horizon of the Saman Shale, is hard and largely composed of orbitoidal foraminifera, and an alga *Lithothamnion*. The fauna is poor in species though rich in specimens, and characterized by an unusual predominance of microspheric over megalospheric specimens. From the foraminiferal fauna and the presence of the alga, of which there are at least two forms, it would appear that the limestone was deposited in a shallow, warm-water bay receiving little drainage from the adjacent land. The new species are adequately illustrated.
A. E.

BOTANY.

(Under the direction of A. B. RENDLE, D.Sc., F.R.S.)

GENERAL.

Cytology.

Chromosome Construction.—JOHN BELLING ("Chromomeres in Liliaceous Plants," *Univ. Calif. Pub. Bot.*, 1931, 16, 153-70). The technique for obtaining fixed and stained smears of pollen mother-cells is given; photomicrographs and camera drawings of the results taken from early and late stages of meiosis are included and analysed. Diagrams of the microstructure of the chromonema, and of the author's own modified hypothesis for crossing over, are given and elucidated, and are demonstrated by reference to certain figures. Synapsis of corresponding chromomeres at zygotene, and the space relations of chromomere "cores" or genes, are observed, also chromosome half-twists occurring at late pachytene. Many results are recorded and discussed, and precise definitions are given for the terms employed. Gene chromatin surrounding each chromomere core, and "extra chromatin," are discussed from a genetical standpoint. Species under consideration include *Aloe striata*, *Lilium pardalinum*, *Uvularia* sp., *Zea* sp., *Canna* sp., *Allium triquetrum*, and *Fritillaria lanceolata*. J. L.

Chromosome Morphology.—JOHN BELLING ("Chiasmata in Flowering Plants," *Univ. Calif. Pub. Bot.*, 1931, 16, 311-38). The hypothesis that considers a chiasma to be the result of openings out, on the one side between homologous chromatids, and on the other between sister chromatids, is contrasted with this second hypothesis: that segmental interchange between homologous chromosomes accompanies the formation of chiasmata. The writer's own hypothesis assumes that half-twists occur in the paired homologues at early pachytene, before the secondary split has begun. This is explained diagrammatically. At each chiasma there will thus be two cross-overs between homologues and two between sister strands. Such half-twists lead to the formation of new connections, the possible types of which are elucidated. Henderson with *Drosophila* and the present author with *Lilium* can give data in accord with this hypothesis. Conditions of chiasma formation, cross-over in triploids, chiasmata at late diaphase, metaphase, and anaphase in *Lilium longifolium* are fully traced, figured, and discussed. Terminal junctions are distinguished from chiasmata, while translocations, reciprocal translocations, inversions, and large deficiencies are explained according to the new hypothesis. J. L.

Chromosome Numbers in the Umbelliferae.—A. WAUSCHER ("Studies on the Chromosome Numbers of the Umbelliferae," *Hereditas*, 1931, 15, 179-84). Chromosome counts taken from meiosis in pollen mother-cells enabled the chromosome numbers of twenty-two species of Umbelliferae to be stated; of these nineteen were new, while the previously stated numbers for *Anthriscus silvestris*, *A. cerefolium*, and *Myrrhis odorata* were checked. Chromosomes were found to shew two distinct types, long and short; these and the bivalent chromosomes occurring in heterotypic

division are figured in the text. A table of chromosome numbers is given, showing an A-series with *eight* as basic number, and a B-series with *eleven*. The possible taxonomic value of such chromosome series is discussed.

J. L.

Chromosome Studies in Cereals.—FUYUWO KAGAWA ("Chromosome Studies of a Species Cross in *Aegilops*," *Bul. Utsunomiya Agric. Col.*, 1931, 1, 57–60). The pollen mother-cells of two F_1 plants derived from crossing *Aegilops cylindrica* Host ($n = 14$) with *A. triuncialis* L. ($n = 14$) were examined cytologically. Chromosome conjugation during first meiotic anaphase is figured and described, and the number of uni- and bi-valents recorded. The diploid number equals 28. The relationship of *A. triuncialis* to the *Vulgare* group (Kihara) is discussed, and the author considers that possibly, in these F_1 plants, allosynesis took place between those chromosomes of *A. cylindrica* which do not form compact gemini with the C genom of *Triticum*, and some of the chromosomes of *A. triuncialis*. Three fertile grains from the self- or cross-pollination of the F_1 plants were cultivated, and their pollen mother-cells examined cytologically.

J. L.

Chondriosomes in Vincetoxicum.—G. PY ("Sur l'évolution des constituants cytoplasmiques des cellules polliniques du *Vincetoxicum officinale*," *Compt. Rend.*, 1931, 193, 22). Pollen mother-cells in *Vincetoxicum* are described, and the development of chondriosomes and plastids and their reactions to different stains are noted. Certain plastids are found to resemble in form the "lepidosomes" recorded by Parat in 1928 in the spermatogenesis of *Helix pomatia*. The results of several other investigators are discussed.

J. L.

Homology of the Blepharoplast.—HIROSHI YAYAWA ("On the Spermatogenesis in *Makinoa crispata* St.," *Cytologia, Int. Journ. Cyt.*, 1931, 2, 157–73). The definition, occurrence, and origin of the body known as the centrosome in different plants according to various investigators is summarized by the author in tabular form. In the liverwort *Makinoa* an aster-like structure is found previous to the meiotic divisions of the large spermatid mother-cells, and subsequent phases are figured and described. No centrosome occurs at the spindle poles (as figured in *Marchantia polymorpha* by the present author and by Ikeno, 1903, and Miyaki, 1905), but a deeply staining granule or blepharoplast is seen to arise *de novo* in the cytoplasm of the spermatid. Cytoplasmic differentiation into inner and outer portions is observed in spermatozooids stained with methyl-green fuchsin solution. Photomicrographs and text-figures are included.

(Owing to the regrettable death of the author, the final preparation of this paper for publication has been undertaken by the editor, K. Fujii, who further adds footnotes and a discussion on the origin of the blepharoplast.)

J. L.

Plastids in Polytrichum.—T. E. WEIER ("A Study of the Moss Plastid after Fixation by Mitochondrial, Osmium, and Silver Technique. I.," *La Cellule*, 1931, 261–290). Divergent views on the nature of plastid development in archesporial tissue are quoted, and the present study proceeds to describe the behaviour of the plastid body, mitochondria, and osmiophilic platelets in *Polytrichum commune*. Technique is described for eight well-known methods previously used for plant or animal tissues. Description of figures is given showing the following: the plastid throughout spore development retains its individuality, and shows a parallelism to the Golgi body in animal cells during meiosis; it is composed of plastonema and plastosome. Continuity of the plastid from cell to cell is brought about by definite cleavage previous to normal mitosis. The details of this process

A 9

are given, and are supported by observations from living material. Mitochondria are distinguished from osmophilic platelets, which are considered distinct cellular elements.

J. L.

Cell Division in *Melosira*.—A. CONARD ("Sur la Division cellulaire chez *Melosira varians* Ag.," *Compt. Rend. Soc. Biol. Belges*, 1929, **102**, 904-6). Division in *Melosira* is studied in the living plant, and is found to be completed in six hours; the rate of growth is found to be $\frac{1}{14}\mu$ per minute. Karyokinesis is obscured by the aggregation of the cytoplasm around the dividing nucleus. The mechanism of division is very precise, the protoplasm being collected laterally half-way down the length of the cell. Daughter nuclei, once they appear, remain in a lateral position until a cytoplasmic septum is completed, when both migrate to the centre, one on either side of the developing cell membrane. Text-figures giving the time relation of the process are included.

J. L.

Mitosis and Spindle Formation in Endosperm.—V. JUNGERS ("Figures caryocinétiques et cloisonnement du protoplasme dans l'endosperme d'*Iris*," *La Cellule*, 1931, **40**, 293-354). Immature seeds of *Iris Pseudo-acorus* were treated in such a way that the embryo-sac and developing endosperm could be removed and mounted for observation. Many nuclei are visible simultaneously, showing all stages of mitosis from early prophase to complete daughter nuclei formed in regular progression from one pole of the endosperm. Outstanding features are as follows: the occurrence of tripolar spindles (rare); the massing together of chromosomes and their irregular orientation before reaching the equatorial plane; regular bipolar spindles with lateral secondary spindles linking adjacent nuclei in triangular figures; aggregation of these triangular groups into "diamonds" and irregular quadrilaterals, and the laying down of cell plates across their axes (both primary and secondary spindles). Instances of the reciprocal influences of nucleus and cytoplasm are given. Results are discussed and illustrated by fifty-four drawings.

J. L.

Cytogenetics of *Nicotiana*.—W. E. LAMMERTS ("Interspecific Hybridization in *Nicotiana*. XII. The Amphidiploid *rustica-paniculata* Hybrid; its Origin and Cytogenetic Behaviour," *Genetics*, 1931, **16**, 191-211). A complete cytogenetic analysis and explanation of the results of selfing and back-crossing an interspecific hybrid and its derivatives was undertaken with regard to the progeny of *Nicotiana rustica-pumila* ♀ × *F₁ rustica-paniculata* ♂. Details of chromosome behaviour and morphological appearance are given with text-figures and photographs. The back-cross progeny (above) show great selectivity in favour of the 24 and 23 chromosome gametes; the pollen also transmits *paniculata* homologues. Three classes of *F₂* plants are observed. (1) Sterile plants resulting from the union of haploid gametes having a total of 24 univalents and bivalents. (2) Sterile plants resulting from the union of diploid and haploid gametes, with about 54 chromosomes. (3) Fertile amphidiploid plants arising from diploid gametes and having about 72 chromosomes. *F₂* and *F₃* amphidiploids show quadrivalents, bivalents, and univalents at first metaphase. Four derivative lines were obtained in *F₄*, which varied about a characteristic type, indicating that the dissociation of the quadrivalents is not strictly preferential. Pairing in *F₁* according to the *Drosera* scheme takes place, yet diploid gamete formation occurs regularly, producing amphidiploids. The importance of this is stressed, as it shows that interspecific hybridization as a factor in polyploidy is not limited to hybrids in which pairing occurs. Results are discussed. The author suggests that the behaviour of these two amphidiploids (*F₃*) with their parents (sterile back-crosses) indicates "that crossability is not a satisfactory index of species relationship."

J. L.

Nicotine Inheritance.—DONTCHO KOSTOFF ("Inheritance of Nicotine," *Biol. Generalis*, 1931, 7, 283-6). Progeny of *Nicotiana* aberrants were found to vary widely in nicotine content. Plants of already known cytological and physiological composition were used for the study of nicotine inheritance. Pure species, and F_1 and F_2 of species crosses, triple and back-crosses were raised and the nicotine content determined. The methods employed are given and the results tabulated. F_1 plants gave a lower nicotine content than the parental average, while F_2 plants varied very widely. Such variations are interpreted on the assumption of the activity of polymer factors, the number of which cannot be determined from the present data. J. L.

Polyploid Gametes in Brassica.—EIJI FUKUSHIMA ("Formation of Diploid and Tetraploid Gametes in *Brassica*," *Jap. Journ. Bot.*, 1931, 5). In heterotype prophase of pollen mother-cells in certain plants of *Brassica japonica* groups of abnormally large cells were observed. Chromosome counts in diakinesis gave diploid, tetraploid, and octoploid numbers ($2n = 20$). The occurrence of abnormal cells in similar groups suggests to the author their origin from single polyploid archesporial cells, tetraploid or octoploid as the case might be. During diakinesis in tetraploid pollen mother-cells twenty bivalent chromosomes normally occur in heterotype metaphase; in a few cases one large ring is observed, which the author considers to be tetravalent. Chromosome doubling could not be ascertained. J. L.

Polyplody in Petunia.—D. KOSTOFF and KENDALL ("Studies in Certain *Petunia* Aberrants," *Journ. Gen.*, 1931, 24, 165-78). A self-sterile tetraploid *Petunia violacea* ($4n = 28$) was crossed with a diploid plant ($2n = 14$), and hybrid offspring were raised with varying chromosome numbers, namely, 28, 27, 21, 20 in somatic cells. The general morphology and kinetic behaviour of these plants is described, with photographs and text-figures. The ratio of formation of 13- and 14-chromosome gametes in the tetraploid, as a result of non-disjunctions in the reduction divisions, was found to be 1 : 6. Meiosis is nearly regular in tetraploids, less so in hypotetraploids, and quite irregular in triploids and hypotriploids. The first two types are self-fertile, the second two self-sterile. Chromosome groups of two, three, and four joined end to end are found during diakinesis. J. L.

Cell Dimensions in Potato.—G. VERPLANCKE ("Étude histologique comparée de tubercules sains, allongés et normaux et de tubercules atteints de *Spindle Tuber*," *Bull. Soc. Roy. Bot. Belg.*, 1931, 63, 13, 139-50). The disease known as "spindle tuber" increases the ratio of length/breadth in all cells of the tissues, resulting in spindle-shaped tubers. A certain tuber from Maine gave rise to elongated tubers on cultivation, but showed no sign of the virus disease present in the parent; these healthy spindle-tubers gave material for the present investigation; cellular dimensions are recorded and compared with dimensions previously obtained with regard to healthy normal potatoes and infected spindle-tubers. Extensive tables of cell measurements are given, showing the ratio length/breadth in different regions. In conclusion, the author finds that though not identical with the ratio for normal tubers, the ratio for the elongated tuber is the same in the majority of cases. Moreover, the increased ratio length/breadth in infected tubers is directly due to the presence of the virus. J. L.

Differential Staining during Mitosis.—CONWAY ZIRKLE ("Nucleoli of the Root Tip and Cambium of *Pinus Strobus*," *Cytologia*, 1931, 2). Root tips and cambial cells of *Pinus Strobus* were fixed in several different fluids so as to preserve

chromatin, plastin (nucleolar-plasm), and mitochondria in the following combinations: (1) Chromatin, plastin, and mitochondria fixed. (2) Plastin, mitochondria fixed, chromatin dissolved. (3) Chromatin and plastin fixed, mitochondria dissolved. (4) Plastin fixed, mitochondria dissolved, and chromatin rendered unstainable. (5) Chromatin fixed, mitochondria dissolved, plastin rendered unstainable. Details of microchemical technique are given. In this way the behaviour of nucleoli independently of chromatin material could be traced during mitosis. Six nucleoli on an average are found in intimate contact with the chromatin threads of the reticulum, and later their material is passed into the spireme and is distributed to the daughter cells; here it once more collects into typical nucleoli. Changes of pH value are described. Mitotic figures and chromosome orientation are clearly photographed. Two distinct substances are observed in resting nucleoli of living cambial cells, neither of which is chromatin. The influence of the plastin and its bearing upon theories concerning the electromagnetic forces involved in cell division is discussed.

J. L.

Tannin Vacuoles.—F. STOCKMANS ("Vacuoles à tanin," *Bull. Soc. Roy. Bot. Belg.*, 1931, 63, 13, 115–32). Tannin vacuoles are located in *Polygonum Bistorta* and *Fagus sylvatica*, and their appearance under different reagents studied to form a basis for comparison. Research into the occurrence of tannin in the resting winter buds of *Myriophyllum verticillatum* and in *Stratiotes Aloïdes* is undertaken. Bensley's solution is used, and different regions of the plants are studied and figured; extensive microchemical tests are undertaken and the results tabulated. In *Myriophyllum* a black coloration with osmic acid, corresponding to that obtained in *Fagus*, indicates the presence of tannin vacuoles. In *Stratiotes* the same treatment yields no result—further tests failing to reveal tannin. Tannin vacuoles in *Myriophyllum* are restricted to adult cells removed some distance from the meristem. On germination the winter buds become relatively rich in tannin. Details of technique are given, with twenty-four figures.

J. L.

Cytology and Germination of Some Zingiberaceæ and Piperaceæ.—

GERTA FORTAK ("Die Cytologie der Keimung einer Zingiberaceen und einer Piperaceen," *Bot. Arch.*, 33, 1 and 2, 97–135, 15 figs., English summary). The Zingiberaceæ have seeds with a perisperm and endosperm. As an example, the seed of *Brachychilus Horsfieldii* has been studied. In this genus the endosperm consists of an inner starch-containing portion, with a substance similar to albumin between the cells, and an outer layer of aleurone cells next to the perisperm. The perisperm consists of "dead" starch-containing cells. At the time of germination of the seed the nucleoli (nuclei?) of the cells of the aleurone layer break up into small particles, and eventually become dissolved. At the same time the perisperm starch shows signs of disorganization, and it is thought that these changes are actually initiated by proferments secreted from the decomposing nucleoli. The endosperm starch is not affected by these changes, from which fact it is deduced that the proferments secreted from the nucleoli of the aleurone layer are incapable of inducing changes except in the perisperm. The embryo itself consists of a foot and an embryo proper. The nuclei of the epidermis of the foot become disorganized at the time of germination, in the same way as those in the aleurone layer. Correlated with this, there are changes in the endosperm starch which are thought to be inaugurated by proferments secreted by the disorganized particles of the nuclei of the epidermal cells of the foot. When seeds are germinated in the light only a part of the starch in the perisperm and endosperm is used up. In the Piperaceæ the seed consists of a large perisperm, a small endosperm, and a small embryo.

This is seen in *Peperomia blanda*, of which the seed has been fully investigated. At the time of germination the embryo and endosperm become enlarged, and the latter completely surrounds the former. The endosperm consists of two parts, of which one, termed the endosperm-bag, swells up and assists in liberating the radicle when it breaks through, and also provides a lubricant which aids in raising the cotyledons. The nuclei of this tissue are at first fusiform, but become decomposed, enter into a period of rest, then become enlarged for a second time, and afterwards throw off small particles. The second part of the endosperm, which is known as the absorbing endosperm, is situated between the perisperm and the embryo, where it is thought to prevent enzymes which dissolve the perisperm starch from gaining access to the embryo itself. It is thought that the nucleolar material cast out from the nuclei of the endosperm-bag secretes proferments which initiate the disorganization of the starch. The perisperm is stated to be devoid of nuclei, and in ungerminated seeds there is a filling material between the cells which stains with Heidenhains hæmatoxylin, but disappears when the seeds germinate. The starch in the endosperm is completely used up during germination, and conducted to the embryo through the cells of the endosperm pocket, which acts as an haustorium.

C. R. M.

Cytology and Development of the Raphide Cells of *Cissus gongyloides* and *Monstera deliciosa*.—ROBERT BECKER and HERMANN ZEIGENSPECK ("Die Zytologie und Entwicklung der Raphidenzellen und die Entstehung ihres Inhaltes bei *Cissus gongyloides* und *Monstera deliciosa*," *Bot. Arch.*, 33, 81-96, 6 figs., English summary). The paper starts with a long review of the literature dealing with the formation of raphide-containing cells, after which the development of these cells in *Cissus gongyloides* and *Monstera deliciosa* is described. The formation of raphide cells begins quite close to the growing point of the root, for which reason the authors consider that the factors which determine which of the cells are to contain raphides must already be present in the cells at the growing point, and are probably situated in the nuclei. The nuclear divisions preceding the formation of raphide cells appear to be normal. The first indication of the formation of raphide cells are to be seen near the nucleus, from which nucleoli are cast off into the surrounding cytoplasm, where they are thought to secrete potential ferments which become activated later on. After these nuclear inclusions have passed into the cytoplasm the latter becomes fibrillar and net-like in appearance, and vacuoles are formed. Later on, the centre of the cell becomes filled with slime, within which the raphides are produced. The authors consider that the vacuolization is initiated by the nucleus, but that the formation of the slime, and eventually of the raphides, is a purely chemical process with which the nucleus is not directly concerned. The oxalic acid is thought to be formed by the respiration of the converted cytoplasm, and this, in conjunction with calcium salts, which accumulate for some cause which is not yet determined, gives rise to the calcium oxalate of which the raphides are composed. The small amount of cytoplasm which remains in the cells after the raphides have been completely formed may play a part in causing the dissolution of the walls between adjoining raphide cells.

C. R. M.

Anatomy.

Effect of Environmental Factors on Wood Structure.—R. KIENHOLZ ("The Effect of Environmental Factors on the Wood Structure of Lodgepole Pine, *Pinus contorta* London," *Geology*, 1931, 12, 354-72, 12 figs.). The paper describes the wood structure of 18 specimens of *Pinus contorta* growing in three major habitats in the same vicinity, namely, poor, scanty soil overlying a lava bed, a

sphagnum bog, and virgin forest on deep soil. From each tree a cross-sectional disc was taken at the 2-foot level, and wood along the average radius was used for the investigation. The lava-bed trees grew under conditions of shallow, poor soil, probably insufficient water at certain seasons, high evaporation rates, strong insolation, and very great diurnal temperature fluctuations. The virgin timber trees grew under conditions of deep but not rich soil, adequate water, low evaporation rates, slight temperature fluctuations, and greater competition with surrounding trees. The sphagnum-bog trees were subject to decided diurnal temperature fluctuations and great differences in temperature of air and soil, low evaporation rates, abundant but probably toxic water supply. As regards growth rate and diameter of the tracheids, this was least in the case of the lava-bed trees, greatest for the sphagnum-bog trees, with the virgin timber intermediate. The same order holds for the percentage of summer-wood. In tracheid length there was a slight difference in favour of the sphagnum-bog trees; the lava-bed trees had the shortest tracheids, with the virgin timber intermediate.

B. J. R.

Wood Structure of *Fokienia Hodginsii*.—C. R. METCALFE ("The Wood Structure of *Fokienia Hodginsii* and Certain Related Coniferæ," *Kew Bull.*, 1931, no. 8, 420-5, 6 figs.). The species examined were *Fokienia Hodginsii* Henry and Thomas, *Cupressus sempervirens* L., *Libocedrus macrolepis* Benth. and Hook. f., *L. decurrens* Torr., *Thuja dolabrata* L., and *T. plicata* D. Don. Characters were found by means of which the woods could be distinguished from one another, at all events in the samples of wood examined. The most important features noted in each of the species are given below. *Thuja plicata*: uniseriate medullary rays from one to twenty cells high, predominantly of about twelve cells. Occasional bordered pits present on the tangential walls of the vertical tracheids. *Thuja dolabrata*: uniseriate rays from one to seven cells high, predominantly one to four. Bordered pits on tangential walls of tracheids confined to autumn wood. *Fokienia Hodginsii*: rays one to fourteen cells high; resembles *Cupressus sempervirens* in having bordered pits in one or more rows on the tangential walls of the tracheids and occasionally rays biseriate in part; parenchyma cells less numerous than in the species of *Thuja* examined, solitary or in pairs, scattered through the wood and not in definite peripheral bands. *Cupressus sempervirens*: rays two to forty-two cells high; large bordered pits locally abundant on the tangential walls of the tracheids. *Libocedrus macrolepis*: numerous small bordered pits on tangential walls of autumn wood tracheids; rays one to twenty cells high, occasionally biseriate in part. Numerous parenchyma cells scattered through the wood, locally aggregated in bands in the autumn wood. *Libocedrus decurrens*: rays not exceeding fourteen cells high; biseriate rays more frequent than in *L. macrolepis*, but it is doubtful whether these two species can be distinguished with certainty.

B. J. R.

Storeyed Structure in Dicotyledonous Woods.—H. H. JANSSONIUS ("Die Verteilung des stockwerkartigen Aufbaues im Holz der Dikotylen," *Rec. des Trav. Bot. Néerlandais*, 1931, 28, 97-106). At first sight the storeyed structure of wood appears to be of little systematic value, as it may be apparent in one species and absent in another closely related species. The importance of this character lies in its connection with a group of other characters. (1) The wood parenchyma strands and substitute fibres exhibit little sliding growth; their wedge-shaped ends are abundantly pitted and are tapered as seen in tangential section, rectangular in radial section. The parenchyma strands have only one or two transverse partition walls, or even none. (2) The wood fibres have wide median portions, which are arranged in horizontal seriation; their ends are markedly attenuate. Pits are

largely confined to the median portions, indicating that only apical growth takes place in these elements. (3) The storeyed elements are relatively short and of approximately the same length. Regarding storeyed structure pure and simple as only one of several manifestations of the storey-complex, the presence of any one of these characters in a species indicates an affinity to a species exhibiting another of the same group of characters. Thus, in the same family one species may show storeyed structure together with all the other correlated features, while another may show only the wedge-shaped ends of the parenchyma strands. The storey-complex appears to be entirely absent from families having woods composed chiefly of fibre tracheids. In these families the vessel perforations are usually scalariform, wood parenchyma is diffuse, and the rays are typically of two kinds, features frequently regarded as primitive.

B. J. R.

Identification of Sandalwood.—K. A. CHOWDHURY ("Sandalwood and its Indian Substitutes," *Indian Forester*, 1931, 57, 431-3, 1 pl.). The wood of *Mansonia Gagei* Drum. bears a general resemblance to true sandalwood, *Santalum album* L. The distinguishing anatomical characters of the two woods are as follows: *S. album*, vessels solitary, individually distinct with a hand lens magnifying ten times, ripple marks absent. *M. Gagei*, vessels commonly in radial groups, just visible with a hand lens, pronounced ripple marks on tangential surface. True sandalwood has a pronounced odour, while that of the substitute in question is rather faint.

B. J. R.

Characteristic Anatomical Features in Dutch East Indian Woods.—L. G. DEN BERGER and A. T. J. BIANCHI ("Over het voorkomen van eenige bijzondere kenmerken bij Nederlandsch Indische houtsoorten," *Tectona*, 1931, 24, 894-903). From a study of the extensive wood collection of the Forest Research Institute at Buitenzorg the authors have compiled a record of the occurrence of certain anatomical features of systematic and diagnostic value. The features dealt with are: interxylary phloem; tier-like or storeyed structure; radial and axial resin-ducts, gum-ducts, and latex tubes; oil-cells or mucilage-cells; rays composed of alternate layers of cells with and without deposits; sulphur-yellow deposits in vessels; yellow or yellowish-green discoloration of the wood; scalariform perforations in most or all vessels.

B. J. R.

Vegetative Anatomy of *Peltogyne paradoxa*.—P. LEDOUX ("Sur la Structure de l'appareil végétatif aérien de *Peltogyne paradoxa* Ducke," *Études sur la Flore du Bas-Amazone*, Brussels, 1930, 1, 1-9, 5 pls.). Two forms of leaflet, megamorphic and micromorphic, are described. The megamorphic leaflets show a tendency towards a bifacial type of structure which is also apparent in a lesser degree in the micromorphic leaflets. The latter are considerably reduced in surface, by comparison with the megamorphic leaflets, but the mesophyll is at least twice as thick, which appears to compensate for the reduction in the leaf surface. The dimensions of the vessel segments in the secondary wood do not exceed 50-65 μ in diameter and 150-220 μ in length. The rays are 1-3 cells or 8-20 μ wide; their height is variable between 35 and 400 μ (average about 200-250 μ). The wood fibres are 6-10 μ in diameter, and the wood-parenchyma cells 8-14 μ .

B. J. R.

Identification of Pines from the Structure of the Needles.—W. M. HARLOW ("The Identification of the Pines of the United States, Native and Introduced, by Needle Structure," *Bull. New York State Coll. Forestry*, Syracuse University, 4, 2A, 1-21, 19 pls.). It is often difficult to identify pine trees when cones are not available. This applies especially to trees in nurseries and young plantations.

In the present paper an attempt is made to identify pine trees from a study of the internal anatomy of the needles of those species of *Pinus* which occur in the United States of America. For the convenience of those who are not familiar with the structure of pine needles, brief notes are given on the external features and internal microscopical appearance of pine needles as a whole. Four pages are then devoted to a dichotomous key to the species of *Pinus*. This is based on such characters as the number of bundles appearing in a transverse section of a needle, the number of needles in a fascicle, and the number and arrangement of the stomata and resin canals, etc. Practical notes on making temporary and permanent microscopical preparations of pine needles are given. The material used in the investigation was obtained from twelve sources outside the United States, and a much larger number in that country. The most important part of the paper is the 19 plates of excellent microphotographs of transverse sections of the needles of the different species of *Pinus* studied. The first plate illustrates a typical pine needle in transverse section, with separate photographs of the tissues composing it more highly magnified; whilst the remainder illustrate transverse sections of different *Pinus* spp. On the page opposite each of the plates notes are given on the needles of each of the species depicted under the following heads: (1) Length of needles. (2) Number per fascicle. (3) Position of stomata. (4) Distribution of resin canals. (5) Nature of hypoderm. (6) Structure of the endodermis. (7) Number of fibro-vascular bundles.

C. R. M.

Anomalous Stem Structure in *Ruscus aculeatus*.—HAMISH BOYD GILLILAND ("Anomalous Stem Structure in *Ruscus aculeatus* Linn.," *Trans. and Proc. Bot. Soc. Edin.*, 30, 4, 284-5, 1 fig.). The axis of the flowering shoots of *Ruscus aculeatus* consists of a hollow cylinder of chlorenchyma, within which is a solid cylinder of lignified cells in which the vascular bundles are dispersed. In some instances vascular bundles are present also within the chlorenchyma, from which they sometimes passed out to a lateral appendage, and at others ran back again into the central cylinder of lignified cells. The chlorenchyma is formed before the central cylinder becomes lignified, and it is suggested that the presence of chlorophyll inhibits lignification.

C. R. M.

Anomalous Secondary Thickening in the Stem of *Rumex dentatus* L.

—A. C. JOSHI ("Anomalous Secondary Thickening in the Stem of *Rumex dentatus* L.," *Journ. Ind. Bot. Soc.*, 10, 3, 209-12, 3 figs.). The primary vascular system of *Rumex dentatus* consists of a ring of collateral bundles separated from one another by medullary rays. Each bundle has an intrafascicular cambium, and the phloem is surrounded on the outside by a sclerenchymatous sheath. At the base of the stem in a few specimens a secondary cambium was observed to arise in the pericycle. Its formation started opposite the primary rays, but afterwards it became continuous. Most of the cells cut off from the secondary cambium towards the inside remained parenchymatous, but a few scattered vessels were also formed. Most of the cells cut off on the outside also remained parenchymatous, but a few developed into sieve tubes. The cortex and epidermis were not ruptured by the pressure resulting from the increase in thickness, because the cells of the cortex towards the pericycle themselves divided, and the daughter cells came to occupy the abundant intercellular spaces originally present in the cortex. In a discussion of the results of this study the author claims that the discovery of a secondary pericyclic cambium in *Rumex dentatus* indicates that the Polygonaceæ are related to the Centrospermales.

C. R. M.

The Course of the Bundles in the Roots of the *Liliifloræ*.—MARGARETE KURSCHAT ("Untersuchungen über den Strangverlauf auf den Wurzeln einiger

Liliifloreen," *Beiheft z. Bot. Centralb.*, 48, 435-50, 3 figs.). According to F. J. Meyer, there are in the plant kingdom five types of bundle system in roots. In type 1 the tracheæ are arranged in isolated groups, which alternate with a corresponding number of phloem groups. All the groups of elements remain separate from one another throughout their course. In type 2 the xylem and phloem groups alternate with one another only at the periphery of the bundle system, whilst the centre is occupied by a woody or non-woody pith. There are connections at different points in the root between adjacent xylem groups or groups which are separated from one another only by one single third group. There are also connections between the individual phloem groups. In type 3 the centre of the bundle system is occupied only by xylem. There are phloem elements only at the periphery of the bundle, so that in a transverse section the xylem appears to be star-shaped. In type 4 there is a solitary xylem strand, which is either stellate or ribbon-shaped in section. In type 5 there are numerous peripheral xylem and phloem groups, as well as a few irregularly distributed at the centre of the root. At intervals throughout their course the central groups are connected with one another as well as with the peripheral ones. In a study of thirty species of Liliifloræ the author found that these plants were not characterized by having roots with vascular systems of only one type. On the contrary, of the five types briefly described above, four were found to occur. Only type 1 was absent—a fact which agrees with the previous conclusion of F. J. Meyer, that type 1 is especially characteristic of Dicotyledons. Type 2 was found in fourteen species, type 4 in twelve, whilst type 3 was noted in three species, and type 5 in one only. The structure of the bundle system does not necessarily remain constant to any one type throughout its course. For instance, it was noted that the roots of *Scilla* showed predominantly the structure of type 3, but sometimes also that of type 4. However, transitions were found not only between types 3 and 4, which have the common feature of a central xylem group, but also between the less closely related types 2 and 3, e.g. in *Lilium Martagon*. A thick root of *Yucca* has the structure of type 5, but near the root tip of the same root the structure is that of type 3.

C. R. M.

The Root Systems of Trees Growing in Sphagnum.—G. B. RIGG and E. S. HARRAR ("The Root Systems of Trees Growing in *Sphagnum*," *Amer. Journ. Bot.*, 18, 6, 391-7, 4 figs.). Six conifers, *Tsuga heterophylla* (Raf) Sargent, *Pinus monticola* D. Don, *Pinus contorta* Loudon, *Thuja plicata* D. Don, *Picea sitchensis* (Bongard) Carrière, and *Pseudotsuga taxifolia* (Lam.) Britton, all occur in *Sphagnum* bogs near Washington, U.S.A. It is remarkable that very few of these trees have been blown down by wind in spite of the fact that the ground in which their roots grow is so ill-adapted to withstand swaying motions induced by wind. In correlation with this it was found that the root systems of these trees spread out further from the trunk than in the same species growing in firmer soils. The young roots are circular in section, but the older ones are eccentric, owing to the greater growth in thickness in a vertical than in a horizontal direction. Transverse sections of old roots are therefore oval, "T"-girder, or "I"-beam shaped. This eccentric growth, in conjunction with the fact that the roots tend to fuse with one another, is thought to increase the mechanical efficiency of the anchorage of the trees growing in *Sphagnum* peat.

C. R. M.

Anatomy of the Chenopodiaceæ and Amarantaceæ.—A. C. JOSHI ("Contributions to the Anatomy of the Chenopodiaceæ and Amarantaceæ. I. Anatomy of *Alternanthera sessilis* R. Br.," *Journ. Ind. Bot. Soc.*, 10, 213-31, 13 figs., 2 pls.). The stem of *Alternanthera sessilis* is remarkable for the fact that in addition to having

a single ring of bundles when young, there are also two additional bundles on opposite sides of the stem within the pith. The additional bundles run straight throughout the length of an internode, but at the nodes they take up a position at right angles to that in which they were situated in the previous internode. In a transverse section of the stem near the growing point only a single ring of bundles is found to be present. However, the first cambial ring is laid down in such a way that it is intrafascicular in all the bundles except two, opposite which it is extrafascicular. These two bundles become the internal ones seen in a slightly older stem. The internal bundles fork at the nodes, and the forked halves become connected with the branch traces, certain branches from the leaf traces, and the rest of the primary bundles of the upper internode, and then become the internal bundles in the lower internode, but in a plane at right angles to that which they occupied in the internode above. At the base of the stem and in the root a succession of cambiums is formed from cells cut off towards the outside by the preceding cambium. By the activity of these successive cambiums concentric rings of vascular bundles are produced. The conjunctive tissue in the stem is always fibrous, but in the root it is parenchymatous in the inner and fibrous in the peripheral rings. The central cylinder in the root is made up of a diarch xylem plate alternating with the phloem groups, and there is a single layer of pericycle. The primary cambium ring develops in the manner which is usual in dicotyledons, but later on successive concentric cambium rings are produced as in the stem. In all secondary and adventitious roots the xylem is triarch. In the seedling the single median bundle of the cotyledon divides into two, "the two phloem and metaxylem halves move wide apart, but the protoxylems curve outwards and form an exarch xylem plate, which is the direct continuation of one of the protoxylem poles of the root. In this way, when the cotyledons join the axis their vascular supply consists of two collateral bundles and a small exarch xylem plate in between the two." C. R. M.

Leaf Structure of Recent and Fossil Myrtaceæ.—HELENA BANDULSKA ("On the Cuticles of some Recent and Fossil Myrtaceæ," *Journ. Linnean Soc. (Bot.)*, 1931, 48, 657-71, 2 pls., 24 figs.). An account of the epidermal structure of the leaves of the Myrtaceous genera *Rhodomyrtus* and *Tristania*, together with descriptions of one fossil member of the former and two of the latter genus. The stomata in *Rhodomyrtus* possess hooked cuticular scales arching over the pore and guard-cells with a cutinized inner rim and a deeply staining inner border. Paired subsidiary cells may occur parallel to the guard-cells. The latter show a T-shaped cutinization at both polar junctions. *Rhodomyrtus sinuata* Band. (*Dicotylophyllum sinuatum* Band.) from the Middle Eocene of Bournemouth possesses occasional "giant" stomata amongst the normal type. Slit-like cavities are occasionally seen on the upper surface. The leaves of *Tristania* resemble those of *Rhodomyrtus* in general, though the stomata are more numerous, often isodiametric, and possess a larger number of encircling epidermal cells. In some species a few isolated "giant" stomata occur, and slit-like cavities with thickened walls are found in the upper epidermis. *T. bournensis* Band. from the Eocene beds of Bournemouth and *T. toscana* Band. from the Tuscany Pliocene show similarities to present-day species. F. B.

New Method for Determining the Proportion of the Length of a Tracheid that is in Contact with Rays.—A. J. STAMM ("A New Method for Determining the Proportion of the Length of a Tracheid that is in Contact with Rays," *Bot. Gaz.*, 92, 1, 101-7, 1 fig.). In order to determine what proportion of the length of a tracheid is in contact with ray-cells it has hitherto been customary to make a large number of direct measurements on tangential sections, or on microphotographs of them. It has now been found that the same result can be obtained

more easily on tangential sections as follows: In photomicrographs of tangential sections a line drawn in any selected plane cuts some of the double tracheid walls and some of the medullary rays. The number of double walls (including in this the number of single walls that are separated by rays) is counted. A count is also made of the number of rays intersected by a line drawn in a transverse plane. The number of rays so intersected divided by the total number of double tracheid walls gives the average ratio of length of tracheid and rays in contact to the total length of both tracheid ray and tracheid, tracheid contact along the radial faces of the tracheids considered, providing the number counted is not too small. In photomicrographs of transverse sections the number of rays intersected by any tangential line divided by the number of double tracheid walls along that line gives "the ratio of the length of tracheid in contact with rays cells to that of the total length of tracheid wall." The ratios obtained by these two methods agree with one another very closely, and also with those obtained by direct measurements. The values of this ratio for all the softwoods examined varied from 0.072 to 0.288. Values of this ratio for any one species vary to a smaller extent, and for different parts of the wood of the same species less still. There is no significant difference between the values for summer and spring wood in any one species. C. R. M.

Retention of Leaves at the Time of Leaf Fall by Species of *Quercus* which are Normally Deciduous.—E. E. BERKLY ("Marcescent Leaves of Certain Species of *Quercus*," *Bot. Gaz.*, 92, 1, 85-93, 11 figs.). It is a well-known fact that certain species of *Quercus* that are normally deciduous sometimes retain their leaves at a time of year when they would normally fall, usually until the following spring. An investigation of the petioles of normal and marcescent leaves was made in order to determine the anatomical differences between them in the region of the abscission layer. Details are given of the mode of development of the abscission layer in normal petioles. It was found that in marcescent leaves an abscission layer develops in precisely the same way as in normal leaves, but that its development is postponed until the spring following the autumn when the leaves should have fallen. Marcescent leaves even on a single plant do not all fall at once, but when once abscission has started the leaves become detached much more rapidly than during a normal fall in autumn. *Quercus coccinea* sheds its marcescent leaves sooner than any of the other species studied, owing to the small diameter of the vascular strands. *Quercus rubra*, on the other hand, which has large vascular strands, is the last amongst the species observed to shed its leaves. C. R. M.

Wound Reactions of Certain Broad-leaved Evergreens.—ROBERT B. WYLIE ("Cicatratization of Foliage Leaves. II. Wound Responses of Certain Broad-leaved Evergreens," *Bot. Gaz.*, 92, 3, 279-94, 7 figs.). In continuation of his work on the wound reactions of leaves, concerning which the first paper (*Bot. Gaz.*, 90, 260-78) has already been noted, the author now describes wounding experiments with the evergreen leaves of *Arbutus Menziesii*, *Gaultheria Shallon*, and *Berberis nervosa*. In *Arbutus Menziesii* and *Gaultheria Shallon* the reaction to wounding is similar to that already described in mesophytic leaves, except that the processes are slower, owing to the thick cell walls and cuticles making it more difficult for the wounded cells to collapse. The wounded cells first collapse and form a protective layer called the pseudocicatrice, and later on a more deeply seated cork layer is formed beneath the pseudocicatrice. The mature leaves of *Berberis nervosa*, on the other hand, are so rigid that the wounded cells cannot collapse. This prevents the formation of the pseudocicatrice, and this in turn inhibits the formation of the cicatrice proper. Hence wounded leaves of *Berberis nervosa* are stated to be especially liable to invasion by fungi. On the other hand, efficient pseudocicatrices

and cicatrices are formed when young leaves of *Berberis nervosa* are wounded, but the barriers formed are progressively less effective the older the leaf. The formation of the cicatrice does not begin until several days after injury, and takes 20-40 days to complete its development.

C. R. M.

Suberization and Wound-Periderm Formation in Sweet Potato and Gladiolus.—ERNST ARTSCHWAGER and RUTH COLVIN STARRETT ("Suberization and Wound-Periderm Formation in Sweet Potato and *Gladiolus*, as affected by Temperature and Relative Humidity," *Journ. Agric. Res.*, 43, 4, 353-64, 7 figs, 1 pl.). When Sweet Potato and *Gladiolus* corms are wounded, suberization of the exposed tissues takes place, after which a more deeply seated cambium is formed which gives rise to a periderm. Both these processes are influenced by temperature and the relative humidity of the air surrounding them. High temperatures and humidities were found to be most favourable both for rapid suberization and periderm formation in the two species selected for study. In Sweet Potatoes periderm is formed readily at temperatures between 22° C. and 34.8° C. if the relative humidity is sufficiently high. Suberization proceeds more vigorously in *Gladiolus* than in Sweet Potatoes, because the storage parenchyma is more uniform in the former plant. In *Gladiolus*, suberization typically proceeded from the outermost layer of cells inwards under sufficiently high relative humidities. However, at a relative humidity of 75 p.c. and a temperature of 12.4° C. the outermost layer of cells remained unchanged. At progressively lower humidities the failure of the outer layers of cells to become suberized was more strongly marked. This irregularity in suberization was not observed in Sweet Potatoes.

C. R. M.

Physiological and Anatomical Investigation of Storage Tracheids and Velamina.—K. PIWITZ ("Physiologische und anatomische Untersuchungen an Speichetracheiden und Velamina," *Planta*, 14, 19-76, 12 figs.). It has long been known that the velamen of the aerial roots of orchids serves for the absorption of water. Renner has investigated the mechanism by which this is accomplished, and the present investigation is an extension of Renner's work by one of his pupils. The water cells known as storage tracheids have been studied anatomically, physiologically, and as far as possible from the standpoint of development. Different types of storage tracheids can be distinguished, each of which is considered in turn. The primary distinction that is made is between living and dead storage cells respectively. To the first of these categories belong cells which, at maturity, retain a living protoplasmic membrane, but also the spiral cells of *Salicornia* spp. as well as the thickened hypodermal cells of *Physosiphon* and *Pleurothallis*. Dead cells are further subdivided into four groups. (1) Cells connected with the bundles, but which never contain air. Of first importance in this category are the "end-tracheids" which occur in numerous genera, especially at the ends of bundle branches (chiefly in leaves). They are not regarded as being important for the storage of water. There are numerous forms intermediate in character between these and true tracheids. They are sometimes formed following cambial activity or they may be primary structures. (2) Cells which are unconnected with bundles, but which never contain air. Examples of this type are the idioblasts of *Reaumaria*, whose storage capacity is thought to be limited on account of the rigidity of the cells. The spirally thickened cells in the pith of *Anacampteros* spp. are also classed in this group. Amongst the monocotyledons, water is stored in this type of cell in *Vanda*, as well as in the roots of *Aerides* and the leaves of *Oncidium* spp. They are characterized in these genera by the possession of a fully developed cork lamella between the middle lamella and the thickening layer. The water cells of *Sansevieria cylindrica* also possesses a cork lamella of the same kind. (3) Cells unconnected

with bundles, containing air when there is a shortage of water. The spiral cells of *Nepenthes*, which are either primary cells or formed by the transformation of more or less specialized spongy parenchyma cells, belong to this group. Similar cells occur in *Liparis*. There are also elongated, spirally thickened cells of this type in *Crinum* spp., which contain air when the transpiration rate is high. The large cork cells in the bulb of *Oncidium flexuosum*, which contain air when there is a water deficiency, are also described. (4) The isolated bundles of *Impatiens* have been regarded as storage tracheids, but the author considers them to be true bundle tracheids. He also considers that structures described as storage tracheids in the rhizome of *Spiranthes* belong in reality to the true vascular system of the plant.

C. R. M.

Structure and Development of Oil Cells.—ROBERT BECKER ("Der Bau und die Entwicklungsgeschichte der Ölzellen und ihres Inhaltes, vornehmlich bei *Peperomia*," *Bot. Arch.*, 33, 48-80, 15 figs., English summary). A study of the development and structure of the oil cells of *Peperomia*, *Laurus*, and the seedling of *Brachychilus*. A large, centrally placed nucleus is present in the homogeneous cytoplasm of the young oil cell. The oil is formed actually in the cytoplasm by a complex process, which is thought to be initiated by enzymes secreted by the nucleus. The formation of the oil takes place at such an early stage that it may be present in the leaf-primordium. The innermost layer of the mature oil cells is a suberin lamella, which is laid down by apposition. The nuclei of adjoining cells are thought to play a part in the formation of the suberin lamella. A small basin (Näpfchen), which is an inwardly directed projection of the cellulose lamella between the oil cell and its neighbour, persists after the suberin lamella has been formed. The cytoplasm of the young oil cell first undergoes changes in the region of the nucleus, where cavities are formed in which the oil is produced. One of the globules of oil thus formed becomes situated near the inwardly directed projection of the cellulose lamella, with which it remains in contact. This oil globule increases in size, the other globules coalesce with it, and the nucleus becomes disorganized. The suberin lamella is then laid down.

C. R. M.

Glandular Hairs on the Leaves of some Indian Halophytes.—D. P. MULLAN ("On the Occurrence of Glandular Hairs (Salt Glands) on the Leaves of some Indian Halophytes," *Journ. Ind. Bot. Soc.*, 10, 3, 184-9, 1 pl.). The four species *Ægiceras majus* Gaertn., *Acanthus ilicifolius* Linn., *Avicennia officinalis* Linn., and *A. alba* Blume, all of which grow in mangrove swamps, are characterized by hairy glands on their leaves. These glands may be present on one or both surfaces of the leaf (depending on the species), and are either situated in pits or covered by hairs. The structure of the glands was of the same type in all of the four species, and consisted of a single stalk cell and a discoid or spheroidal head of cells with granular contents. The author believes that these glands act as "salt-secreting hydathodes." If plants of *Acanthus ilicifolius* and the psammophilous *Clerodendron inerme* are transferred from their natural habitats to a mesophytic environment it is stated that the glands are not so fully developed.

C. R. M.

Notes on Salt-Marsh Plants.—I. MARGARET A. MOIR ("Glauz maritima Linn.," 7 figs.); II. DAVID F. STEWART ("Plantago maritima Linn.," 1 fig.); III. JAMES PARK ("Triglochin maritimum Linn.," 2 figs.), *Trans. & Proc. Bot. Soc. Edin.*, 30, 4, 304-25. In 1904 Zelenky formulated a conception of xeromorphy which was later confirmed by Yapp and others. These workers established the general rule that "the anatomical structure of the individual leaves of one and the

same shoot is a function of their distance from their root system; and the higher the leaf is inserted on the stem, the more xerophytic is its structure." In these short papers accounts are given of studies of plants of *Glaux maritima*, *Plantago maritima*, and *Triglochin maritimum* respectively from different habitats, in order to determine if these plants agreed with the general rule stated above. General agreement with this rule was found. Notes on the stem and root anatomy of *Glaux maritima* and *Plantago maritima* are given, as well as on that of the seedling of *Triglochin maritimum*. C. R. M.

Stomata on Citrus Leaves.—H. S. REED and E. HIRANO ("The Density of Stomata in Citrus Leaves," *Journ. Agric. Res.*, 43, 209-22, 9 figs.). A study of the distribution of stomata on the leaves of *Citrus* spp., especially Valencia oranges (*Citrus sinensis* Osbeck) and Eureka lemons (*Citrus Limonia*). The stomata of citrus leaves are confined to the ventral surface of the lamina, and they arise at an early stage in the development of the leaf. In mature leaves the size of the stomata varies, those that are formed late being smaller than those that are formed early in the development of the leaf. The long axis of the stomata near the leaf margin are parallel to the leaf margin, whilst between the lateral veins they are parallel to the veins. Near the midrib they are parallel to the midrib. No fresh stomata are formed after a leaf has reached about a fourth of its mature size. Stomata are more abundant in lemon than in orange leaves. Their distribution is not uniform throughout the leaf surface, but the greatest numbers are found at the centre, whilst at the apex and base of the leaf they are less numerous, but more numerous at the apex than at the base. Stomata are absent for some distance around oil glands, large stomata, and hairs where these are present. Observations on the density of the stomata per unit area of leaves of different ages showed that they were most numerous on young leaves at the time when fresh stomata cease to be produced. The maximum growth in area of orange leaves was observed near the centre and the minimum near the apex. A relationship was found to exist between the density of the stomata on lemon leaves and the position of the leaves on a shoot. This relationship, however, was not found to be true in short shoots. The individual stomata were not found to vary appreciably in size according to the number present per unit area. The density of stomata was less in shaded than in unshaded leaves.

C. R. M.

Stomata on Citrus Leaves.—E. HIRANO ("Relative Abundance of Stomata in Citrus and some Related Genera," *Bot. Gaz.*, 92, 3, 296-310, 1 fig.). The number of stomata on *Citrus* leaves appears to be correlated with the amount of rain that falls in the spring, rather than with the total annual rainfall. Light, heat, and atmospheric humidity are also thought to play some part in determining the number of stomata produced. Most species of the Aurantioideae growing in the tropics have more than 500 stomata per sq. mm., whilst on those in cooler countries they are not so dense. Some species, such as *C. paradisi*, are able to live in a wide range of conditions, but others, such as *C. Limonia*, thrive best in places having a Mediterranean type of climate. Generally speaking, the stomata are less dense in hardy varieties than in those which are not. There are, however, exceptions to this rule.

C. R. M.

Structure and Water Relationships of the Plants of the Kara Kum Desert.—I. M. VASSILIEV ("Über den Wasserhaushalt von Pflanzen der Sandwüste im Südöstlichen Kara-Kum," *Planta*, 14, 225-309, 51 figs.). The work described in this paper was carried out at the desert laboratory of applied botany of the Soviet Union at Rapetek in south-eastern Kara Kum. Much of the subject-matter

is physiological, but is concerned with the relation between the structure and life histories of the plants comprising the desert vegetation and their environment. In an average year the rainfall at Kara Kum reaches 100 mm., most of which falls during the late summer and early spring. During the greater part of the summer no rain falls, the temperature reaches 50° C. in the shade, the surface of the sand is heated to 80° C., and it is seldom cloudy. The relative air humidity at midday falls below 10 p.c. The wind usually blows at a speed of 7-8 metres per second, and the air is full of dust. The soil is held together by the roots of the plants that cover it. The water content of the sand is very low, but under shrubs it is sometimes 0.7 p.c. and rarely 4 p.c. or more. All the plants growing in the desert are shrubs or trees, with the exception of *Carex physodes*, which has a curious life history (see below). The mode of life of the plants is largely determined by the water content of the layer of sand in which their roots grow. The roots of *Smirnovia turkestanica* and *Ephedra strobilacea* do not penetrate more deeply than two metres, and therefore do not reach the permanent underground water supply. Consequently their growth ceases at the end of August or the beginning of September. The large leaves of *Smirnovia turkestanica* gradually lose water in time of drought; they therefore grow smaller and are finally lost. The rest of the plants have root systems which penetrate more deeply into the permanent water-level in the sand. However, the water supply of these plants is obtained chiefly from the overlying layer of sand, in which the water content fluctuates. In the summer, when the water content of this layer is low, the actively transpiring *Ammodendron Conollyi* throws off some of its leaves. The behaviour of the stomata was studied in detail. Strips of the epidermis of certain plants were removed at intervals and fixed in absolute alcohol. For some plants this was done at intervals throughout a whole day in June and August respectively, but for others it was done only throughout a day in June. The stomata of all the plants remain closed at night and begin to open at sunrise. The maximum apertures were observed between 7 and 9 o'clock, and they began to close again at midday. In August a second maximum opening occurs in the evening, but they close again when the sun goes down. Experiments in which *Ammodendron Conollyi* were watered showed that the opening of the stomata of this plant is not altered by this treatment, whereas in August they open more widely in watered than in unwatered plants. This is thought to indicate that plants of this type have a sufficient water supply in June but not in August. It was mentioned above that *Carex physodes* is the only herb that exists in the desert. This plant ceases to grow at the end of May, when the dry period begins; the tissues become dried up, but none the less retain their vitality, and when moisture is again available the plant revives. The plants of the Kara-Kum desert are divided into two classes: (1) perennating ephemerals of the *Carex physodes* type, and (2) perennial woody plants. Amongst these plants there are some which take up and transpire very little water, and others which are extravagant with water and transpire freely. Plants with a low rate of transpiration were found to be more thermophilous than those with a high one. The ability of the poorly transpiring plants to resist drought depends on the capacity for heat resistance of the green cell. Plants with a higher rate of transpiration do not have a strong heat resisting capacity, but their temperature is regulated by the high rate of transpiration. The chief way in which water shortage in these plants is overcome is by loss of evaporating surface.

C. R. M.

Effect of Light Intensity and Soil Moisture on Plant Anatomy.—
WILLIAM T. PENFOUND ("Plant Anatomy as Conditioned by Light Intensity and Soil Moisture," *Amer. Journ. Bot.*, 1931, 18, 558-72, 8 figs.). A study of the

effect of controlled physical conditions on the structure of selected species of plants. Variation of light intensity without appreciable effect on air temperature and humidity was effected by means of a special lath shelter. Plants of *Helianthus annuus* L. and *Polygonum Hydropiper* L. were grown both in full sunlight and below the shelter. In twenty-eight days the average total transpiration in sun and shade respectively was 3610 c.c. and 821 c.c. for *Helianthus*, and 3125 c.c. and 1190 c.c. for *Polygonum*. In both species the sun plants were more robust, possessed more leaves and a higher number of stomata per unit area than the shade plants. The root systems were more extensive and the roots thicker. Whereas, however, the leaves in the sun plants of *Helianthus* were larger than the shade leaves, in *Polygonum* the converse was the case. In another experiment plants of *Helianthus annuus* were grown in sun and shade conditions as before, without, however, the addition of water. After three weeks the external features of the two sets of plants were much the same as in the first experiment, save that the height of the plants was greater under the shelter. Anatomical investigation revealed that in the sun plants the roots possessed more xylem and a greater diameter, while the hypocotyls showed a greater percentage area of xylem. The internodes also possessed a greater diameter. The increased height of the shade plants was due to an increased number of cells, and not merely to an increase in length of individual cells. In the sun plants the leaves were thicker. It was found that, in spite of a poorer root system and smaller conducting area, the shade plants were as well equipped in their water balance as the sun plants. Other experiments showed that increased soil moisture augmented the size and thickness of the leaves, that mesic plants need abundant available water to thrive in an atmosphere of relatively high evaporating power, and that the drier the soil the smaller the transpiring surface served by a unit area of vascular tissue. The results suggest that soil moisture content may be more important than light intensity in determining interrelationships of water conduction and water loss.

F. B.

Influence of Calcium Deficiency on the Root Tips of Zea Mays L. and Triticum vulgare Vill.—RONALD BAMFORD ("Changes in Root Tips of Wheat and Corn Grown in Nutrient Solutions Deficient in Calcium," *Bull. Torr. Bot. Club.*, 58, 149-78, 2 figs., 5 pls.). If seedlings of wheat and maize are grown in culture solutions deficient in calcium, the cells of the root tips gradually lose their contents. The nucleus is not at first affected, but afterwards degenerates into a heterogeneous mass. The cell walls remain unchanged, so that eventually the cells have the appearance of a "line drawing in a text-book." These changes begin in the epidermis and peripheral part of the cortex, but afterwards cells that are more deeply seated are affected. Degeneration does not depend solely on the calcium content of the culture solution, but on the ratio of the calcium to magnesium, or of the calcium to all the other components of the solution. When the Ca/Mg ratio was 5/95 or higher there was no disorganization of the cell contents. The contents of the cells of the root tips were also unchanged when the calcium salt was present in a concentration of 2.5 p.c. or more of the total molecular concentration of the solution. The rate of root growth "was roughly proportional to the calcium content of the solution or to the Ca/Mg ratio." The growth of lateral roots was prevented by growing the seedlings in solutions from which calcium was absent. The changes occurring in the cells of the root tips deficient in calcium are illustrated by a series of very clear microphotographs.

C. R. M.

Effect of Continuous Electric Light in Addition to Normal Daylight on the Growth and Structure of Some Caryophyllaceæ.—FRANCIS RAMALEY ("Some Caryophyllaceous Plants influenced in Growth and Structure by

Artificial Illumination Supplemental to Daylight," *Bot. Gaz.*, **92**, 311-20, 18 figs.). Seeds of *Agrostemma celi*, *Dianthus barbatus*, *D. Caryophyllus*, *D. chinensis* Hedderwigii, *D. plumarius*, *Gypsophila paniculata*, *Saponaria multiflora*, *Silene acaulis*, *S. inflata*, and *Viscaria viscosa* were grown from seed to maturity in a greenhouse. They were subjected to the continuous light of two 100-watt electric lamps in a reflector above them, as well as to the natural daylight. These plants grew taller than the controls (growing in the same greenhouse, but shielded from the direct rays of the lamps), flowered earlier, and had slender stems in which the vascular tissues (especially the phloem) were poorly developed. The roots were short, starch was absent from the pith and cortex of the stem, leaves were abnormally thin, and sometimes had only a single palisade layer.

C. R. M.

Morphology.

Morphology and Ecology of *Ranunculus parviflorus* L.—E. J. SALISBURY ("On the Morphology and Ecology of *Ranunculus parviflorus* L.," *Ann. Bot.*, 1931, **45**, 539-78, 1 pl., 20 figs.). An intimate study of the morphology of this species, with special reference to the flower and an account of its ecology and geographical distribution. A study of the plant's phyllotaxis reveals an irregular arrangement, the angular divergence of any two successive leaves varying from 89° to 159°. Always, however, any one complete turn around the stem passes through three leaves, which, it is suggested, is the true significance of the Fibonacci series. The hypothesis that the apical meristem is a multicellular derivative of a three-sided apical cell is elaborated. The leaves are shown to possess stipules, and stomata are present on both surfaces. Marginal water pores function particularly in the immature leaves, which, by their close investiture of hairs, have difficulty in ridding themselves of surplus water by transpiration alone. The stomata range from 5-93 and the epidermal cells 127-397 per sq. mm. of leaf surface, while the stomatal index averages about 16. The stomatal aperture is from 1-3 p.c. of the entire leaf area. It is shown that the irregular orientation of the stomata bears no relation to the increasing irregularity of the maturing epidermal cells. The stomata are raised above the epidermal level, and twin- and half-stomata are recorded. Conspicuous intercellular air spaces are found in the petiolar ground tissue and the cortex of the root, a character of the hygrophyte or mesophyte rather than the xerophyte. Serial sections of young flower buds show the parts to be produced in a sequence of threes in each complete spiral turn, while such displacements as occur are explained on mechanical grounds. The quincuncial calyx is held to represent two whorls of three members each, in which one inner and one outer member are congenitally fused. The corollary that the total number of floral parts should be one less than a multiple of three is borne out by countings in over seven hundred examples, twenty-six parts being the most frequent condition. The sepals are shown to represent leaf bases, while the petals have originated from the stamens. Staminal dehiscence, even in a damp atmosphere, is induced by the nectaries, which act as osmotic hydathodes. A wide variation in numbers of floral parts exists with a range of K. 4-5, C. 0-5, A. 1-8, G. 3-18. Between the stamens and petals exists a negative correlation. Normal seed output per plant is 250 achenes, while favourable conditions produce up to 6700 achenes per plant. Dispersal is probably by rain-wash, and germination, the percentage of which is high, takes place in September and is simultaneous. The species grows less successfully on calcareous soils. In the ovule, uni- and multicellular archesporia are recorded, as also the occurrence of a tapetal cell. Anatrochous before fertilization, it later becomes amphitropous. A carpellary swelling above the ovule suggests an abortive ovule,

while the anatomy approaches the condition met with in a follicle. The distribution of the species is Atlantic in type. Primarily a species of moist habitats, its association in Britain with shallow soils and dry habitats is conditioned by a greater frost resistance on these soils and a relief from competition of tall species. F. B.

Morphology of *Gladiolus*.—N. E. PFEIFFER ("A Morphological Study of *Gladiolus*," *Contrib. from Boyce Thompson Instit.*, 3, 2, 173-96). Newly harvested *Gladiolus* corms, after chemical treatment by methods described elsewhere (Amer. Journ. Bot. 17, 602-12), were placed in a cellar at a low temperature at the end of the summer. The development of the corms, which belonged chiefly to the varieties "Halley" and "Alice Tiplady," was studied in detail. The examination was purely superficial until the shoot elongated, but once this process started buds were fixed at intervals and their development studied by means of sections. When the shoots began to appear the corms were placed in a greenhouse. Mitotic divisions were observed twelve to eighteen days after the corms were treated. The internodes at the base of the stem expanded laterally before the upper ones became elongated, and gave rise to the terminal flower spike. The development of the microsporangia and ovules is normal. The fertilized egg gives rise to a massive embryo, a short suspensor and a basal cell, all of which develop from a single row of cells. The endosperm has thick hemicellulose walls. C. R. M.

Morphology of *Citrus* Leaves.—J. C. TH. UPHOF ("Zur Morphologie des Citrusblattes," *Rec. des trav. bot. Néerlandais*, 28, 1 and 2, 107-12, 3 figs.). An account of some observations on the leaves of certain *Citrus* spp. and hybrids, from which it is concluded that the leaves of those *Citrus* plants which are apparently simple represent in reality compound leaves which are reduced. This conclusion is based partly on a twig of the variety of orange known as "Mediterranean Sweet." On one part of this twig the first pair of leaves were normal, but bore winged petioles 24-28 mm. wide, attached to which was a second leaf with a winged petiole 35 cm. broad, and a normal terminal leaf 12 cm. \times 6 cm. There was a normal joint between the petiole and lamina. A third independent leaflet was attached to the second one at a joint between the lamina and petiole. A tree of the F_1 generation, in a cross between *C. trifoliata* \times *C. sinensis* Osbeck, was usually provided with a three-partite compound leaf, showing that the *C. trifoliata* type was dominant. If an F_1 plant of this type was crossed with *C. (Fortunella) marginata* Swingle a triple hybrid resulted, in which there were leaves of all stages intermediate between a compound leaf with three leaflets and a normal joint at the junction of the lamina and winged petiole and simple leaves. The author considers that the leaves of *Citrus* spp., which are apparently simple, represent a three-partite compound leaf, in which the two lowest nerves represent a relic of the central nerves of the two lateral leaflets of the originally compound leaf. C. R. M.

Floral Morphology of the Cruciferae, with a Discussion on Teratology and Atavism.—A. ARBER ("Studies in Floral Morphology. II. On Some Normal and Abnormal Crucifers: with a Discussion on Teratology and Atavism," *New Phyt.*, 1931, 30, 172-203, 13 figs.). This paper is the second of a series, of which the first has already been noted (*New Phyt.*, 1931, 30, 11-41). It deals chiefly with the abnormalities in floral structure noted in different Cruciferae, together with some observations on the normal structure as well. The first plant to be considered is *Capsella Bursa-pastoris* Medic., which is compared with *C. Viquieri* Blar., which differs from it in having a quadrilocular gynoeceum. The relationships between these two types is thought to be most easily explained by assuming that the normal crucifer gynoeceum is bicarpellary (as opposed to the view of E. R. Saunders). In

C. Viguieri the author considers that two additional carpels are present facing one another in the antero-posterior plane, "with their margins inserted between those of the existing carpels." Another important point is that the valve and replum strands of *C. Viguieri* are interdependent, and the strands for the central ovule-bearing lobe are derived from the replum strands. It is shown that in *Diplotaxis tenuifolia* DC., *Crambe maritima* L., and *Sisymbrium Alliaria* Scop. the bundles of the lateral sepals are given off before those for the median pair. This is in contrast to the view that the bundles to all the four sepals are given off at the same level. The true positions of the lateral sepals is often shown by their margins becoming enwrapped by the margins of the upper median sepals. By means of serial microtome sections it was shown that the placental strands were derived mainly, if not entirely, from the valve bundles in *Diplotaxis tenuifolia*. Flowers of *Diplotaxis tenuifolia* and *Brassica alba* Boiss., when infected with the fungus *Cystopus candidus*, showed an abnormally large amount of vascular tissue, and the stamens were liable to be abortive and multifasciculate. In a previous paper the author described paired squamules associated with the pedicels of certain cruciferous flowers, and put forward the suggestion that these might represent the stipules of the absent bracts. This suggestion has now been confirmed by a study of *Nasturtium officinale* R. Br., in which they are unusually well developed. An account is also given of some abnormal inflorescences of *Nasturtium officinale*, in which some of the flowers were provided with subsidiary flowers. This abnormality was especially well developed at or near the base of the inflorescence. The vascular strands of the accessory flowers were found in all cases to be derived from the petal strands of the "parent" flower. The author considers that the relation of the accessory flower to the parent flower is of the same type as that of an axillary shoot to its parent axis. She does not regard them as axillary. A description of an abnormal flower of *Sisymbrium Alliaria* is also given. This plant, which was unhealthy and infected by an unidentified animal parasite, had four of its flowers replaced by partial inflorescences, and one by an abnormal open gynœcium. The paper ends with a discussion of abnormality and atavism. The author considers it to be an unsound principle to assume that abnormalities are reversionary. That this is so is particularly well illustrated by the abnormal inflorescences of *Nasturtium officinale* with accessory flowers. If it be assumed, as suggested by E. R. Saunders, that the gynœcium of *Capsella Viguieri* is "ancestral," it must also follow from similar considerations that the ancestral crucifer flower had an accessory flower associated with each petal, as noted in the abnormal *Nasturtium officinale* inflorescences—a suggestion which is clearly absurd. The author ends with a plea for the study of abnormalities for their own sake. "Their interest deepens when they are divested of their specious claim to rank as genealogical sign-posts." C. R. M.

Hermaphrodite Cones of *Pinus longifolia* and *Picea morinda*.—L. N. RAO ("Bisporangiate Cones of *Pinus longifolia* and *Picea morinda*," *Journ. Ind. Bot. Soc.*, 10, 3, 232-6, 2 pls.). A note on a bisexual cone of *Picea morinda* Link collected from a tree 8500 feet above sea-level. There was evidence of insect damage to the tree, and although the cone may have developed abnormally as a result of insect attack, there was no clear indication that this was so. The base of the cone bore scales of the type normally found at the base of female cones, but the next portion towards the distal end was made up of microsporophylls. Finally, the distal half of the cone bore typical macrosporophylls. Several bisexual cones of *Pinus longifolia* (Salis.) were also found at Ootacamund, 8000 feet above sea-level. The bisexual cones of this species could not be distinguished from the normal ones at an early stage, but later on it could be seen that they bore normal scales at the

base of the cone, and in the axils of some that were further towards the distal ends there were male cones varying in number from 10 to 14, and in length from 3 to 8 mm. Next to these axillary male cones there was a girdle of microsporophylls. The distal ends of the cones bore only normal macrosporophylls. C. R. M.

Polyembryonic Coniferous Seeds and their Germination.—TEMA SHULTS CLARE and GEORGE R. JOHNSTONE ("Polyembryony and Germination of Polyembryonic Coniferous Seeds," *Amer. Journ. Bot.*, 1931, 18, 674-83, 1 pl.). Five conifers were investigated: first, to observe the occurrence of two seedlings from one seed; second, to ascertain the nature of the embryos; third, to indicate the degree of elimination of the endosperms. Germination experiments were carried out on previously chilled seeds. In *Pinus Torreyana*, out of 173 seeds germinated, there were two cases of two well-developed seedlings from single seeds. Each seedling possessed ten cotyledons, and in one instance five of them were shorter than the remainder. Mechanical pressure during development is suggested as a cause. Out of ninety-four seeds of *Pinus Sabiniana*, two instances of two seedlings from one seed arose. One case developed from a control unchilled planting. Each seedling had seventeen cotyledons, and one seedling showed slight zygomorphy. In *Pinus cembroides* var. *monophylla* two instances of two seedlings from one seed were observed. Polyembryony was noted in *Pinus Torreyana* in one out of fifty seeds, and two equally developed embryos were seen. *Pinus Sabiniana* showed a similar proportion of polyembryonic seeds. In *Pinus cembroides* var. *monophylla*, in thirty-nine good seeds out of fifty, seven showed 2-6 embryos each. *Pinus Coulteri* and *P. tuberculata* showed no polyembryony. Seeds of *P. Torreyana*, *P. cembroides* var. *monophylla*, and *P. Banksiana* were dissected, and weights of endosperm and embryo determined. The weight of embryo divided by weight of endosperm gave an endosperm "elimination quotient." Figures obtained showed *P. cembroides* var. *monophylla* to possess a smaller quotient than the other two species, while the embryos were much smaller. Such facts probably indicate a more favourable condition for the development of multiple embryos. It was impossible to say whether the "twin" seedlings observed were "fraternal" or "identical." F. B.

Morphology of the Gynoecium.—W. TROLL ("Beitrag zur Morphologie des Gynoeciums," *Planta*, 14, 1-18, 12 figs.). After pointing out that there is no clear line of demarcation between an apocarpous and syncarpous gynoecium, the author expresses his views on the structure of the gynoecium in the Hydrocharitaceæ. Previous investigations have led to the conclusion that the gynoecium in this family consists of a syncarpous ovary with parietal placentation. However, the author now considers it is to be interpreted as an apocarpous gynoecium, in which the carpels themselves are free, but united with one another only through the cup-shaped receptacle. This has been confirmed both by studies of the development of the gynoecium as well as by comparisons of it with that of the Butomaceæ. The ovules, as in the Butomaceæ, arise from the walls of the carpels, and not from their margins. The structures which have been described as cloven or double placentæ are stated to consist, in reality, of the wings of the lamina of adjacent carpels projecting into the interior of the ovary. Certain genera of the Hydrocharitaceæ possess undivided placentæ. In these plants it is thought that at an early stage at the base of the ovary their real "double" nature can be detected. Both divided and undivided placentæ occur amongst the *Vallisnerioideæ* and *Halophiloideæ*. The possession of undivided placentæ does not serve to distinguish these groups from the *Stratioteæ* and *Thalassioideæ*, as undivided placentæ have also been described in *Hydrocharis*. It is thought that in correlation with the fact that the margins of

the carpels of *Vallisneria* and *Halophila* do not extend into the cavity of the ovary, only a single whorl of carpels is produced in these forms. C. R. M.

Suspensor of *Sciadopitys*.—JOHN T. BUCKOLTZ ("The Suspensor of *Sciadopitys*," *Bot. Gaz.*, 92, 3, 243-62, 19 figs.). At an early stage the embryo of *Sciadopitys* consists of a prosuspensor, below which are situated the embryo initials. At the end of the prosuspensor away from the embryo initials there are sometimes a greater or smaller number of rosette cells. It is thought that a terminal cap cell above the rosette cells may also be present, although no definite evidence of this was found. The cells of the prosuspensor become elongated, and, whilst this is happening, the embryo initials give rise to one-celled primary suspensors and the embryos. The rosette cells, when present, are also thought to represent embryo initials, but they usually become aborted at an early stage. In the embryos which develop there is a stage at which an apical cell can be seen. The primary suspensor becomes a multicellular secondary suspensor, owing to its being reinforced by the formation of an embryonal tube. Twelve to twenty-eight embryos may arise from a single archegonium. If three eggs are fertilized, an embryo complex may be formed with several times this number of separate embryos. A seed, when mature, usually contains only one embryo with two cotyledons, in spite of the fact that the embryos may be further multiplied by budding at a late stage. Embryos with three cotyledons were sometimes seen. The stem tip is not organized until long after the cotyledons are formed. There is a discussion on the relationship of *Sciadopitys* to other Coniferæ on the basis of their embryology. It is thought that the embryo of *Sciadopitys* is a type from which the embryos characteristic of both the Cupressinæ and Taxinæ may have been derived. "It has probably had a common origin with the embryo type represented by *Cephalotaxus* and certain podocarps, and appears to be more distantly related to the Abietinæ." C. R. M.

Embryology of *Daucus Carota*.—H. A. BORTHWICK ("Development of the Macrogametophyte and Embryo of *Daucus Carota*," *Bot. Gaz.*, 92, 23-44, 32 figs.). The embryology of the Umbelliferæ has received little attention except for the detailed work of R. Souèges (Compt. Rend. Acad. Sci. Paris, 182, 339) on *Carum Carvi* L. Souèges found that the embryology of *Carum Carvi* was in some ways similar to that of the Rubiacæ and Solanacæ, for which reason the author considered that a similar study of *Daucus Carota* would be of interest. In *Daucus Carota* a single archesporial cell divides to give rise to a linear tetrad of macrospores. Three of the macrospores degenerate, and the chalazal one develops in the manner usual in Angiosperms. The presence of cellulose in portions of the synergidæ was demonstrated. Pollen tubes grow down through the tissues of the style, but at the base grow superficially through grooves leading to the micropyle. Fertilization was not actually observed, although all the stages before and after this process were seen. The endosperm nucleus divides several times before the fertilized egg nucleus does so. The zygote divides transversely to form an eight-celled linear embryo. The three cells furthest from the micropyle give rise to all parts of the embryo except the root tip. The other five cells go to form the root tip and suspensor. Souèges's investigations led him to suppose that the four-celled stage of the embryo is all important, and that its component cells always go to form the same parts of the embryo. This is not true of *Daucus Carota*, where the mature embryo may arise from the distal cell of the four-celled linear embryo, or from the distal cell together with derivatives of the cell next to it. Certain differences were observed between the embryology of *Daucus Carota* and that of *Carum*, which indicates that a single type of embryology is not necessarily constant throughout a family. C. R. M.

Embryology of *Cuscuta monogyna* Vahl and *C. Epithymum* L.—

W. FEDORTSCHUK ("Embryologische Untersuchung von *Cuscuta monogyna* Vahl und *Cuscuta Epithymum* L.," *Planta*, 14, 1, 94–111, 26 figs.). An account of the development of the male and female gametophytes, and of the embryo after fertilization in *Cuscuta monogyna* and *C. Epithymum*. Reduction division in the anthers is normal. At diakinesis seven bivalent chromosomes were counted in *C. Epithymum*. The author found that the primary pollen grain does not divide at the centre as described by Peters (in an unpublished thesis written in 1908), but at the periphery. An important difference between the two species was that whereas in *C. Epithymum* two sperm cells consisting of nucleus and cytoplasm were produced in the ungerminated pollen grain, in *C. monogyna* the production of sperm cells was not observed to take place until after germination. In *C. monogyna* the division of the generative nucleus is suspended at a late prophase stage, and does not proceed further until the pollen grain germinates on the stigma. In some instances abnormalities in the development of the male gametophyte were noted. This included (1) the formation of three sperm cells, (2) the production of two vegetative nuclei in one pollen grain, (3) the division of the protoplast of the pollen grain into two equal or unequal parts. When this happened there was usually a generative cell in one part only. Droplets were produced on the walls of the tapetal cells, and when this happened the contents of the cells gradually disappeared. In both species the archesporial cell was in the sub-epidermal layer. The development of the eight nuclei within the embryo-sac proceeds normally. The antipodal cells disappear prematurely. The pollen tube penetrates the embryo-sac between one of the synergids and the wall of the embryo-sac, and the contents of the pollen tube are discharged directly into the lumen of the embryo-sac. In *C. Epithymum* both the synergids were destroyed after fertilization, but in *C. monogyna* one synergid persisted and took part in the development of the embryo as a large haustorial cell. In *C. Epithymum* the basal cell of the two-celled embryo gives rise to a suspensor of four uninucleate cells. In *C. monogyna*, on the other hand, a four-celled suspensor is produced, each cell of which contains several nuclei. A suspensor of this type is stated to be present also in certain Leguminosæ. C. R. M.

Embryology of *Pistia Stratiotes*.—A. E. SHADOWSKY ("Einige Angaben über die Embryogenie von *Pistia Stratiotes* L.," *Ber. deutsch. bot. Gesch.*, 49, 7, 350–5, 1 pl.). An account of the early stages in the embryology of *Pistia Stratiotes*, based on material grown in the botanic garden at Moscow. In ripe pollen grains there are two generative and one vegetative nucleus. A true periplasmodium is present, which has not been observed by previous workers. On the surface of the ripe pollen grains there are ridges running parallel with the longitudinal axis of the grain, which in transverse sections of the grain have the appearance of ovals. At an early stage the grain is situated in a vacuole, and demarcated from the surrounding protoplasm by a wavy line situated where the future exine subsequently develops. The anatropous ovule of *Pistia* is provided with two strongly developed integuments. In the inner integument there are tabular cells which represent the limiting layer of the tapetum. The embryo-sac usually developed from the lowest of the four macrospores, of which the upper three become disorganized. However, in some preparations three macrospores were observed. In these instances the two upper macrospores degenerated, and the lowermost one functions as the mother-cell of the embryo-sac. The embryo-sac contains the usual eight nuclei, and is bounded at the micropylar end by the remaining cells of the nucellus, and at the side by the tapetal cells. Fertilization was not observed, although germinating pollen grains were found on the stigma, and pollen tubes were observed

at the micropyle, where they remained for a long time. The endosperm cell immediately beneath the chalaza usually has a large nucleus, which is much larger than that of the upper endosperm cells. This nucleus was found to divide into two, but it was not possible to observe in detail the further development of the daughter nuclei. Large glands were formed during the development of the embryo and endosperm. During the development of the seed the cells of the outer integument increase in size, especially at the opening of the micropyle. The details of the development of the embryo and seed were not observed. The author concludes that the Aroideæ-Pistioideæ and Lemnaceæ should be grouped together, on account of their having in common a periplasmodium and pollen grains with three nuclei.

C. R. M.

New Interpretation of the Morphology of the Grass Embryo.—

LUCY BOYD ("Evolution in the Monocotyledonous Seedling: a New Interpretation of the Grass Embryo," *Trans. and Proc. Bot. Soc. Edin.*, 30, 286-303, 5 figs.). The author believes that the chief evolutionary tendencies in monocotyledonous seedlings are: (1) from the epigeal to the hypogeal habit; (2) earlier development of the plumule, and decreasing importance of the radicle; (3) from the non-ligulate to the ligulate type of cotyledon; (4) reduction of the vascular system of the cotyledon; (5) for the embryo to become more fully developed within the seed before germination. An outline of previous concepts of the morphology of the grass embryo is given and a new one is put forward. According to this, the scutellum is "a double structure consisting of (1) a vascular plate bounded by the epithelium and equivalent to the suctorial tip, and (2) an inner non-vascular plate which is adpressed to the embryonic plumular organs, and is equivalent to part of the cotyledonary ligule." A fragment of the sheathing base of the cotyledon is represented by the epiblast. The ventral scale represents the "vestigial apex of the ligule of the cotyledon." The mesocotyl is the internode between the cotyledon and the first leaf. The coleoptile is equivalent to the first foliage leaf.

C. R. M.

Embryology of *Allium* and *Nothoscordum*.—A. MESSERI ("Ricerche embriologiche e cariologiche sopra i generi *Allium* e *Nothoscordum*," *Nuov. Giorn. Bot. Ital.*, 1931, 38, 409-41, 66 figs.). The nucellus of the ovules of the genera *Allium* and *Nothoscordum* is of the apodermal type. The female gametophyte of *Allium roseum* var. *bulbilliferum*, *A. nigrum*, *A. subhirsutum*, *A. neapolitanum*, *A. Schœnoprassum*, *A. triquetrum*, and of *Nothoscordum fragrans* is of the dimegasporial type as in *Scilla*; in *Nothoscordum striatum*, however, this is very rare, and the monomegasporial type usually occurs. In *A. nigrum* and *A. subhirsutum* the nucleus of the upper of the two cells which degenerate during megasporogenesis never divides. Mature gametophytes were never observed with less than seven nuclei, of which two were chalazal. In *Allium* the mature gametophyte may be eight-nucleate or seven-nucleate; in the latter case there are only two antipodals. In *Nothoscordum* the mature gametophytes are always eight-nucleate with three antipodals. The synergidæ always show an obvious filiform apparatus. In *A. neapolitanum* there may be a reduction in the antipodal apparatus up to its complete suppression. In *A. nigrum*, *A. subhirsutum*, and *A. Schœnoprassum* the formation of an antipodal oosphere was encountered, and the two antipodals associated with it resembled synergidæ, one of them occasionally showing rudimentary filiform apparatus. The basic chromosome number in *Allium* is eight, this number being found in *A. nigrum* and *A. Schœnoprassum*. *A. roseum* var. *bulbilliferum* was found to have twenty-four, and is considered to be a hexaploid variety of a diploid species in which polyploidy is associated with apomyxis (the flowers are transformed into bulbils). In

Nothoscordum eight is again the basic number. *N. fragrans*, in which there are twelve, is considered to be triploid. A. W. E.

Pseudo-Germination in Canapa.—SAVELLI, R. (" Osservazioni sulle Pseudo-germinazioni della *Canapa* e fenomeni affini," *Arch. Bot.*, 1930, 6, 102-8). The word "pseudo-germination" is in current use to denote the phenomena resembling those of germination, such as the protrusion of the radicle, which take place in a dead seed through the action of the agent causing death. The author extends this definition to cover all phenomena resembling germination which take place in a dead seed, whether caused by the actual lethal agent or occurring as the result of any treatment of a seed already dead, and all similar phenomena in seeds which are non-viable owing to a hybrid constitution, which does not permit the embryo to advance beyond the stage of intra-seminal vitality. The phenomena of pseudo-germination in dead seeds are due to the physical effects of treatment with various acids or with boiling water. The embryo swells and sets up a pressure which causes the protrusion of the radicle, the whole mechanism being sharply different from that of true germination. True germination cannot be said to have taken place unless reserves of albumen have been utilized. Many cases of so-called "germination" in old seeds and in seeds of hybrids may really be no more than pseudo-germination, unless the experiments are carried far enough to establish the fact that true germination has taken place. On the other hand, an embryo which fails to germinate may still have been alive though lacking sufficient "force" (potenze prospettive) for germination. A. W. E.

The Ligule in Monocotyledons.—A. PONZO (" Sulla ligula delle Monocotiledoni," *Nuov. Giorn. Bot. Ital.*, 1931, 38, 515-33). As the result of observations based on materials from the principal families of monocotyledons, the author concludes that the ligule is an appendage which originates and develops at the point of union of the lamina or petiole and the sheath. It results from proliferation either of the epidermal layer only or also from adaxial parenchymatous tissue from the apex of the sheath. It is a secondary formation from the sheath and has no true organic value, as it is always more or less ephemeral in duration; it lacks vascular bundles, or, if the latter are present, they are ramifications of those of the sheath which penetrate into the laminar region. The origin of ligules with or without vascular bundles is identical, and there is no reason to differentiate in morphological value between them. The author considers that the presence of the ligule in no way contradicts his theory of synphyly in the monocotyledons. A. W. E.

Subterranean Organs of *Helianthus scaberrimus* Ell.—WILLIAM S. COOPER and ABRAHAM D. STOESZ (" The Subterranean Organs of *Helianthus scaberrimus*," *Bull. Torr. Bot. Club*, 1931, 58, 67-72, 2 figs.). The root system of *Helianthus scaberrimus* Ell. consists mainly of a few adventitious, simple, succulent roots, which, extending horizontally up to 1 metre, turn abruptly downwards for about 80 cm. One to ten horizontal rhizomes per plant are also produced, which resemble the roots in appearance. These may extend to 102 cm. in length and bear terminal fleshy buds. Adventitious roots are produced by the potential plants, and on the death of the parent at the end of the season produce a group of new individuals. Viable seed was not found. The occurrence of a "fairy ring" is described, which, in 1927, was 11 metres in diameter and consisted of a belt of plants 2-4 metres wide. The central area contained few plants. The individuals from without inwards showed a progressive decrease in size and in flowering. A transect was laid out from the centre to the outer margin, and it was noted that the rhizomes showed an average of 1.55 per plant. A striking feature was the outward direction

of growth of most rhizomes in the dense area. In 1928 the ring had extended outwards for distances up to 1.25 metres. The average figure of rhizomes per plant was 2.4. In 1929 the ring had disappeared, a few scattered plants remaining. Suggested causes for the ring formation are less severe competition for soil water at outer margin or some chemical modification of the soil due to the plants. The latter explanation seems more probable, though greenhouse cultures in soils taken from various parts of the ring gave conflicting results. F. B.

Vegetative Propagation of *Acalypha*, *Dioscorea*, and *Stenoglottis longifolia*.—R. J. D. GRAHAM and L. B. STEWART ("Studies in Vegetative Propagation: *Acalypha*, *Dioscorea*, and *Stenoglottis longifolia*," *Trans. and Proc. Bot. Soc. Edin.*, 30, 282-3, 1 pl.). *Acalypha Wilkesiana* was successfully propagated from complete leaves with petioles, leaves removed from their petioles, and even from portions of the lamina when the veins were cut. The root development originated in the "cells of the vascular bundles external to the xylem." Attempts made to propagate *Dioscoreas* from leaves were also successful. A tuberous structure bearing fibrous roots was produced at the base of the leaf, and the only photosynthetic organ during the first year was the parental leaf. When this leaf died the plant perennated by means of the tuber. The orchid *Stenoglottis longifolia* was also successfully propagated from pieces of leaf. C. R. M.

Phytonism.—J. C. SCHOUTE ("On Phytonism," *Rec. des trav. bot. Néerlandais*, 28, 1 and 2, 82-96). A review of the literature on phytomic theories is first given. The work of Gaudichaud, Schultz, and Delpino is dismissed on account of its unreasonableness. Celakovsky's views are taken more seriously, and examined in detail. Nevertheless, the author says of Celakovsky "he has shown that phytonism might be in accordance with the facts," or "it is possible to construct a scheme of thought which fits in with phytonism and with many facts. This is much more than any phytomist ever did before." The author then attempts to demonstrate that phytonism is a fallacy, because it is inconsistent with the facts of phyllotaxis. The following is an example of the type of argument used: supposing for instance that in a plant with a regular spiral phyllotaxis every phyton gives rise to a daughter phyton $n + 1$ at such a distance as the divergence requires, the genetic spiral would constitute "a real chain of coherent phytons." However, in a sunflower head with a Fibonacci spiral each bract n would be separated from $n + 1$ by numerous other bracts. Hence, unless every phyton forms a complete transverse slice of a stem, there is no possibility of contact with the next lower and higher number. If a sunflower head had a phyllotaxis of $34 + 55$, there would be 88 internodes between a given bract and the next one above it, and every internode would be 50μ thick, or less than the dimensions of a single parenchyma cell. The author regards pericaulom or leaf-skin theories as less objectionable but unnecessary, and ends by stating that probably leaves of macrophyllous plants have sprung from lateral branch systems like the fertile stems of *Asteroxylon*. C. R. M.

Influence of the Buds on the Growth of the Stem of *Asparagus plumosus* and *A. Springeri*.—J. OSTERHUIS ("Der Einfluss der Knospen auf das Stengelwachstum von *Asparagus plumosus* und *A. Springeri*," *Rec. des trav. bot. Néerlandais*, 28, 1 and 2, 20-74, 15 figs.). This paper is divided into three chapters, in which the following subjects are considered: (1) The influence of the terminal and axillary buds on the growth of the stem. (2) The influence of the terminal and axillary buds on the stretching and division of the cells. (3) The type of influence which governs the growth of the terminal and axillary buds. There is a short

recapitulation at the end of each chapter. It is concluded that the growing part of the stem must act as a whole, in which the growth rate rises to a maximum on passing from below upwards, and then falls off on passing still higher up the stem. These conditions hold good in the stems of *Asparagus plumosus* and *A. Springeri*. By means of growth measurements of stems which were decapitated, deprived of their axillary buds, or from which the terminal and axillary buds had been removed, it was found that the growth is governed exclusively by the axillary and terminal buds. Measurements of the average length of the cells in stems which have been deprived of their buds showed that the influence of the buds is effected primarily by changes in the stretching of the cells, although there was found to be some influence due to the number of cell divisions as well. If the growing point of a decapitated stem was replaced by a new one, the latter had the same influence on geotropical curvature as the original. A geotropic reaction was also obtained with decapitated stems in which the apical growing point was replaced by the growing apex of another stem (not necessarily of the same species) fixed on by means of a small funnel filled with gelatine. It is thought that the stimulus exerted by the buds is due to the presence of a growth-promoting substance. C. R. M.

Factors which Govern the Formation of Mature Apple Fruits.—FREEMAN S. HOWLETT ("Factors Affecting Fruit Setting. I. Stayman Winesap," *Bull.* 483, *Ohio Agric. Expt. Stat.*, 1-54, 14 figs.). This paper is the first of a series describing investigations to discover what determines the capacity of different varieties of apple to set fruit. The variety chiefly dealt with is Stayman Winesap. Much of the subject-matter is physiological, but notes are given on the results obtained by a microscopical examination made at the time of macrosporogenesis. A fuller account of the microscopical observations is to be published elsewhere. It is concluded that the most important factor in determining premature falling of the fruit is competition for food and water between the individual flowers in the clusters. Pollination experiments showed that Stayman Winesap is not readily self-pollinated. The microscopical examination showed that irregularities in macrosporogenesis were common, whereby many weak, functionless spores and gametes were produced. Weak, unstable embryos were also formed after irregularities at meiosis. These irregularities are also of importance in determining whether Stayman Winesap matures or not. No similar irregularities were observed in the variety Jonathan. C. R. M.

CRYPTOGAMIA.

Pteridophyta.

Ankyropteris.—H. S. HOLDEN ("Some Observations on the Wound Reactions of *Ankyropteris corrugata*," *Journ. Linnean Soc. (Bot.)*, 1931, 48, 643-55, 1 pl., 16 figs.). Well-marked reactions to wounding occur in the tissues of the fossil fern *Ankyropteris corrugata*. In the cortical parenchyma of the root they consist of irregularly disposed wedges of meristematic tissue, and may extend for some distance beyond the actual wound area. In the stem the wounds generally take the form of irregular cortical fissures, and are bordered on either side by a strip of meristem 4-8 cells in depth. Anomalous secondary xylem occurring in a stem near a bifurcation is also probably due to traumatic stimulus. In the petiole the wound reaction varies. Where the wound is superficial a pad of healing meristem is developed from the cortical cells. While the parenchymatous cells are the most active, the sclerenchymatous may also divide. Exceptionally, the superficial cells may become modified. "Crush" wounds are characterized by irregular cortical fissures; and

these are bordered by meristematic cells. In deep-seated wounds the vascular tissues may react; in such a case there is a development of secondary tracheids, short and narrow, varying in position according to the wound. Apparently also phloem or phloem parenchyma may show a meristematic reaction. A. G.

Embryology of *Osmunda*.—GEORGE L. CROSS ("Embryology of *Osmunda cinnamomea*," *Bot. Gaz.*, 1931, 92, 210-17, 8 figs.). The first wall in the embryo of *Osmunda* is parallel with the longitudinal axis of the archegonium, and usually with that of the thallus; the second wall is perpendicular to it, forming a typical quadrant stage; and this is followed by an octant stage. The primary appendages cannot be referred in origin to definite halves, quadrants, or octants of the embryo. The primary leaf, stem, and root arise from approximately one-half of the embryo adjacent to the neck of the archegonium. The foot consists of the half of the embryo next the gametophyte. The root is endogenous in origin. The preceding features, when considered collectively, indicate that *Osmunda* stands nearer the eusporangiate than the leptosporangiate level. The two main points in common with the eusporangiate ferns are: (1) the origin of the leaf, stem, and root from the same half of the embryo, and the foot from the other half; (2) the occasional presence of an incipient suspensor. The contrasting points are: (1) the position of the first wall with respect to the axis of the archegonium; (2) the direction of growth of the embryo. The *Osmundaceæ* appear to be intermediate embryologically between the eusporangiate and the leptosporangiate ferns. A. G.

Fern Prothallia.—DAVID M. MOTTIER ("Development of Sex Organs of Fern Prothallia under Prolonged Cultivation," *Bot. Gaz.*, 1931, 92, 218-23, 2 figs.). The continuation shoots (clones) of individual prothallia of *Matteuccia nodulosa* and *Osmunda Claytoniana* were kept under cultivation for eight years. Their continued existence was made possible by preventing the development of sporophytes. The vigorous clones attained the size of *Marchantia*, had a pronounced midrib and branched dichotomously. When growing most vigorously and rapidly the clones bore, as a rule, only archegonia. Less favourable conditions of growth facilitated the production of antheridial proliferations from the older parts of the midrib and from the thinner margins. The proliferations became exhausted in the production of antheridia and dried up. The author holds that his investigation firmly supports the theory that sex is quantitative and not qualitative. The spores and their resulting gametophytes are bisexual haploids. Vigorous growth leads to the production of archegonia almost exclusively, while less vigorous growth results in antheridial proliferations on the same clones. A. G.

Ceratopteris.—M. DORISSE HOWE ("Origin of Leaf, and Adventitious and Secondary Roots of *Ceratopteris thalictroides*," *Bot. Gaz.*, 1931, 92, 326-9, 9 figs.). A study of the buds formed in the notches of the leaves of plants of *Ceratopteris* growing in the University of Chicago greenhouse. These buds rapidly develop into new plants. It was found that the leaf initial develops from the outside portion of the segment of the apical cell of the main axis. The initial of the first adventitious root at the node develops from a hypodermal cell derived from the cell immediately below the leaf initial. Later roots may develop from cells derived from the leaf initial. These roots are also hypodermal in origin. The secondary root develops from a layer occupying the position of the endodermis in the primary root. A. G.

Lycopodium.—RICHARD J. EATON ("Notes on *Lycopodium inundatum* and its Allies in the Western Hemisphere. I. A New Variety of *Lycopodium*

inundatum," *Rhodora*, 1931, 33, 201-3). A description of *L. inundatum* var. *robustum*, a new variety found at Concord, Massachusetts, which in the past has been confused by some collectors with *L. alopecuroides*. A. G.

Bryophyta.

Riella.—R. A. STUDHALTER ("Germination of Spores and Development of Juvenile Thallus of *Riella americana*," *Bot. Gaz.*, 1931, 92, 172-91, 25 figs.). Spores of *Riella americana* from Texas were germinated in water, and the plants were studied in the living state. The spore contains numerous oil drops, and forms a large vacuole opposite the point of rupture, which is at the middle of the outer face; the emerging germ tube contains great numbers of oil drops, and, growing apically, attains a filamentous stage comprising four to seven cells, which soon display chloroplasts. The primary rhizoid originates between the spore and the nearest cross wall. Beginning with the apical cell, most of the cells of the filament divide by longitudinal and transverse walls to form a broadened primary thallus, one cell in thickness, the base of which remains as a meristematic zone. Secondary rhizoids arise from cells between this thallus and the spore. The meristematic zone becomes localized at one or both sides, producing one or two lateral outgrowths in the same plane as the primary thallus, the tip of which is resorbed. The distal portion of the lateral outgrowth becomes the wing of the adult plant, and the proximal margin (toward the spore) thickens by cell divisions in the third dimension to form the stem. The adult plant becomes erect or ascending by a curvature of the axis of growth. The filamentous stage is radially symmetrical, and the primary thallus is bilaterally symmetrical. The later stages are not dorsiventral, and are bilaterally symmetrical only in the plane of the wing. A. G.

Riella.—CH. DOUIN et L. TRABUT ("Les anomalies du *Riella* et leurs enseignements," *Travaux Cryptogamiques dédiés à Louis Mangin*, Paris, 1931, 11-20, 1 pl.). An account of the morphology of *Riella*, partly based on notes by the late L. Trabut, with description of the stem, ramifications, buds on the wing, growing points and their divisions, modes of reproduction. Though the fructifications appear to be lateral, yet *Riella* is truly acrogynous; the fruits are always terminal on a branch, however reduced it be. Ramifications are of three kinds: branches of internal origin; bifurcations numerous, perfect or imperfect; false dichotomies. The branches vary in size, and are either normal or reduced and fruit-bearing or rudimentary and filamentous. The growing points divide on one side only to form the wing, and divide into two initials in any plane to form bifurcations. The initials of the rudimentary branches divide only at their base, producing either fan-shaped structures or leaves and fructifications. *Riella* is allied to *Sphaerocarpus* by its wing, its female involucre, and its fruits; it also much approaches *Fossombronia* by its leaves, its bifurcations, and the arrangement of its fructifications. The wing, the male involucre, and the filamentous rudimentary branches are peculiar to *Riella*. A. G.

Fossombronia.—CH. DOUIN ("La Réhabilitation du *Fossombronia*," *Rev. Gén. Bot.*, 1931, 43, 246-68, 3 pls.). A re-examination of the morphology of *Fossombronia*. Though, when adult, the plant may appear to be anacrogynous, yet in the young state it quite evidently is acrogynous, the perianth being always apical on a leafy stem. The branching is truly dichotomous, arising from division of the growing point; one or other branch may develop feebly or become modified. Bipartition of the growing point may take place longitudinally, transversely, or obliquely. If division is longitudinal, the two branches are lateral; if transverse,

the two branches are superposed; if oblique, the upper covers part only of the under branch. In each perianth there is a solitary archegonium. Sterile archegonia situated on the stem are apical on short branches, the result of imperfect bifurcations where the growing point had divided transversely or very obliquely. In *Fossombronina* almost all the leaves are normal with decurrent base; but longitudinal leaves lack this character. A. G.

Chiloscyphus.—ROBERT DOUIN ("Sur le Gametophyte et l'Inflorescence du *Chiloscyphus polyanthus* Corda," *Rev. Gén. Bot.*, 1931, 43, 169-76, 8 figs.). An account of the morphology of *Chiloscyphus*, its leaves and their variations of shape; the stem shows ventral branches, lateral branches, and bifurcations. Lateral branches arise as buds at the upper or posterior angle of the leaves, and are covered at first by an envelope, through the top of which they thrust their way. Ventral branches are more rare, and are borne in the axil of the amphigastria. The bifurcations are true dichotomies. The inflorescence is peculiar in that in the axil of the same lateral leaf is found an antheridium at the anterior angle, and an archegonial branch at the posterior angle. A. G.

Swedish Grimmiaceæ.—HJALMAR MÖLLER ("Lövmossornas utbredning i Sverige. XI. Grimmiaceæ I. *Hydrogrimmia*, *Coscinodon*, *Schistidium*, *Racomitrium*," *Arkiv för Botanik*, 1931, 24A, no. 2, 1-177, 28 figs.). An account of the distribution in Sweden of fifteen species of Grimmiaceæ and their varieties, with notes, figures, and diagrams of distribution, bibliography, and index. A. G.

Mexican Mosses.—I. THÉRIOT ("Quelques nouveautés bryologiques pour le Mexique," *Travaux Cryptogamiques dédiés à Louis Mangin*, Paris, 1931, 7-10, 2 pls.). A list of seven mosses, additions to the Mexican flora. Two of them represent new genera: *Bryomanginia* (allied to *Pleuridium*) and *Hymenolomopsis* (allied to *Hymenoloma* and *Blindia*); the type of each is a species new to science, and is described and figured. A. G.

Thallophyta.

Algæ.

Algal Classification.—A. PASCHER ("Systematische Übersicht über die mit Flagellaten in Zusammenhang stehenden Algenreihen und Versuch einer Einreihung dieser Algenstämme in die Stämme des Pflanzenreiches," *Beih. z. Bot. Centralbl.*, 1931, 48, ii. 2, 317-32). A systematic review of the series of algæ related to the Flagellatæ, and a proposed classification of these algal tribes—Chrysophyta, Phæophyta, Pyrrophyta, Euglenophyta, Chlorophyta, Charophyta, Rhodophyta—in the general scheme of the plant kingdom. A. G.

Hyaliella.—A. PASCHER ("Über eine farblose einzellige Volvocale und die farblosen und grünen Parallelförmigen der Volvocales," *Beih. z. Bot. Centralbl.*, 1931, 48, i. 3, 481-99, 17 figs.). Description of *Hyaliella polytomoides*, a new genus and species of the Volvocales and of the family Polyblepharidaceæ, a colourless organism; and a discussion of some parallel organisms of the Polyblepharidinæ, Chlamydomonadinæ, and Cocomonadinæ, with green or with colourless contents, and with or without a cell membrane. A. G.

New Chlorogonium.—A. PASCHER ("Über einen neuen einzelligen und einkernigen Organismus mit Eibefruchtung," *Beih. z. Bot. Centralbl.*, 1931, 48, i. 3, 466-80, 10 figs.). Description of *Chlorogonium oogamum*, a new green, unicellular, uninucleate, free-living organism of the Volvocales and of the family Chlamydo-

monadaceæ. It is oogamous; the contents of the female cell is converted into an egg, while the contents of the male cell becomes divided into numerous spermatozooids; the egg is extruded from the mother-cell membrane previous to fertilization. This is the second record of a coloured unicellular uninucleate oogamous organism. Comparisons are made with some other algæ. A. G.

French Volvocaceæ.—J. FELDMANN ("Sur deux Volvocacées nouvelles pour la Flore Française," *Rev. Algolog.*, 1931, 6, 88, 89, 1 fig.). A note on the occurrence of *Asteromonas gracilis* on salt marshes at Croisic near the mouth of the Loire in September, 1929. Its characteristics are described. *Brachiomonas Westiana* was found in a shallow pool at Croisic. Both these algæ belong to the Volvocaceæ, and both are additions to the French Flora. A. G.

Brachiomonas.—ROB. LAMI ("Le *Brachiomonas Westiana* Pascher dans la baie de Saint-Malo," *Rev. Algolog.*, 1931, 6, 89–92, 1 fig.). *Brachiomonas Westiana* was found in brackish pools near Saint-Malo in 1930. Although it tolerates very variable degrees of salinity, it prospers best in water of feeble salinity, in which a trace of phosphate and nitrogenous matter is present. A. G.

Chlorococcum infusionum.—HAROLD C. BOLD ("Life History and Cell Structure of *Chlorococcum infusionum*," *Bull. Torrey Bot. Club*, 1931, 57, (1930), 577–604, 5 pls., 5 figs.). An account of the unicellular alga *Chlorococcum infusionum* (Schränk) Meneghini, which is stated by the author to be identifiable by the following characters: loose cœnobium originating from zoospores; cells 8–30 μ diameter; inner cell wall thin, of cellulose, outer thick gelatinous and lamellate; chromatophore parietal, often containing oil drops and one (or two) angular or spherical pyrenoid; cells uninucleate, becoming multinucleate only just before cleavage. Multiplication is effected by formation of biciliate zoospores and non-motile aplanospores, both arising by progressive cleavage of a mother protoplast into uninucleate segments; a portion of the pyrenoid is received by each daughter protoplast. Cell bipartition does not occur. Gamete fusion was not observed. Environmental factors influence the formation and development of zoospores and aplanospores: (a) zoospore formation depends upon a sufficiency of moisture to permit their escape; in dry cultures potential zoospores develop a thick gelatinous membrane and have no motile stage. (b) In solutions of low concentration zoospores are rapidly formed; in more concentrated solutions multiplication is by aplanospores. (c) Slight changes of temperature cause liberation of zoospores. The pyrenoid is associated with starch formation; and the author discusses the derivation of starch grains by excretion from complex proteid molecules. A. G.

Pleodorina illinoisensis.—PIERRE ALLORGE ("Le *Pleodorina illinoisensis* Kofoid dans le plancton de la Seine," *Rev. Algolog.*, 1931, 5, 436–8). In 1921 the Seine at Meulan reached the temperature of 79° F. in the first week of August, and for five days the surface of the river had a water-bloom consisting almost entirely of Volvocaceæ: *Volvox aureus*, *Eudorina elegans*, *Pandorina Morum*, *Gonium pectorale*, *Chlamydomonas*, and a new record for the French flora—*Pleodorina illinoisensis*. In addition, a few Protococcales were intermixed. The whole of this phytoplankton was dispersed by a violent storm that occurred on the night of August 9th, and became replaced by the normal summer plankton of the Seine—the diatoms *Atheya Zachariasii*, *Asterionella gracillima*, *Melosira italica*, *Synedra actinastroides*, *S. delicatissima*, and some Protococcales. Besides North America, *Pleodorina illinoisensis* has been recorded from Germany, Russia, and Great Britain. A. G.

Kamtchatka Diatoms.—STELLAN ERLANDSSON ("Marine Diatoms Collected by the Swedish Kamtchatka Expedition, 1920-22," *Arkiv för Botanik*, 1931, 23A, no. 8, 1-10, 3 figs.). A list of forty-six species and varieties of diatoms, mostly epiphytic, on a large colony of *Schizoneima Grevillei*, collected at Akhomten Bay, on the east coast of Kamtchatka, by E. Hultén, in September, 1920. A new species of *Achnanthes* is described. A. G.

Thermal Algæ.—M. FAMIN ("Contribution à l'étude systématique et biologique de la flore thermale française," *Travaux Cryptogamiques dédiées à Louis Mangin*, Paris, 1931, 71-83). A number of lists of the algæ obtained from various hot springs in France, together with the temperature, salinity, and relative acidity of the waters, at Evaux-les-Bains (Creuse), Thudès-les-Bains (Pyrénées-Orientales), Dax (Landes). In the cooler waters two mosses and a few Chlorophyceæ were noted, but it is Cyanophyceæ and some diatoms that are the common features, including a fair number of Chroococcaceæ, very few Chamaesiphonaceæ and Vaginariaceæ, a predominance of Lyngbaceæ, rather few Heterocystaceæ. A. G.

Arthrospira.—FLORENCE RICH ("Notes on *Arthrospira platensis*," *Rev. Algolog.*, 1931, 6, 75-9, 2 figs.). An account of *Arthrospira platensis*, a blue-green alga found abundantly in the plankton of three Rift Valley lakes in Kenya in 1929. Originally collected in Uruguay, it was recorded from Kenya by W. and G. S. West in 1896, and from Lower Egypt in 1924 by the present author. A supplementary description of the organism and its measurements and various sketches of its spirals are given. The water of the lakes was exceptionally alkaline; and flamingoes were feeding almost exclusively upon this alga. A. G.

Hertfordshire Pond Algæ.—LUCY J. HOWLAND ("A Four Years' Investigation of a Hertfordshire Pond," *New Phytologist*, 1931, 30, 221-65, 7 figs.). An account of Welham Pond, near North Mimms, and of a careful study of its flora from 1925 to 1929, under the following headings: physical features and vegetation of the pond; the annual cycle; environmental data, comprising water-level and salinity, CO₂ content and pH of water, meteorological data; periodicities of certain forms, filamentous, unicellular, and colonial motile forms, non-motile unattached forms and diatoms, epiphytic diatoms, other epiphytes; consideration of the periodicities of the species under classes; reproduction of forms; exhaustion of species; summary of results. A. G.

Galician Algæ.—VALIA et PIERRE ALLORGE ("Hétérocontes, Eulichlorophycées et Conjuguées de Galice. Matériaux pour la Flore des Algues d'eau douce de la Péninsule Ibérique I," *Rev. Algolog.*, 1931, 5, 327-82, 16 pls.). A list of 379 species and fifty-nine varieties of fresh-water algæ, two-thirds at least of which are new records for the flora of the Iberian peninsula. One species of desmid and ten varieties are new to science; forty-one species of desmids have been noticed with zygospores; and several zygospores are described or figured for the first time. The list is preceded by notes on the geography and flora of the region explored. A. G.

Albanian Algæ.—ACHILLE FORTI ("Osservazioni biologiche sopra alcuni laghi dell' Albania orientale," *Atti Accad. Veneto-Trentino-Istrianica*, 1931, 21, 121-32). This includes an account of the fresh-water algæ collected by P. Parenzan, mostly in Lake Ochrida in eastern Albania, in 1929. It comprises two Characeæ, two Florideæ, eleven Chlorophyceæ, seventeen Conjugatæ, eight diatoms, four Peridineæ, four Flagellatæ, sixteen Myxophyceæ. A. G.

Reproduction of *Cladophora*.—E. MARION HIGGINS ("Note on the Life-History of *Cladophora flavesceus*," *Ann. Bot.*, 1931, 45, 533-4). Ripe sporangia were common on a sample of *Cladophora flavesceus* gathered in brackish water at Pooyl Vaaishie on the south-west coast of the Isle of Man in March, 1930. The released zooids settled after swimming for some twenty minutes, mostly without fusing; such fusions as were observed took place usually between pairs, but occasionally three would fuse end to end. When fixed and stained the material revealed that nuclear division had taken place in specimens fixed between dusk and midnight. As already shown by Schussnig in 1928 and 1929, so here also it was found that two generations, morphologically similar but cytologically distinct, occur closely mingled in this species, the vegetative nuclei of the diploid plant having twenty-four chromosomes and those of the haploid plant twelve chromosomes. On haploid plants no reproductive organs were found; but on diploid plants sporangia were usual, and permitted a study of all the phenomena of reduction division. As to the behaviour of the spores after release, the writer discusses the significance of the occurrence of a small percentage of fusions amid the crowd of asexual zoospores.
A. G.

Crystals in *Cladophora*.—E. CHEMIN ("Les cristaux protéiques chez quelques espèces marines du genre *Cladophora*," *Compt. Rend. Acad. Sci. Paris*, 1931, 193, 742-5, 1 fig.). An account of the proteid crystals observed in the sap of *Cladophora prolifera*, *C. pellucida*, and *C. rupestris*. The crystals are regularly tetrahedric in *C. pellucida*, and cubic in the other two species. They were found in all the cells of all the specimens examined at all times of the year; but they were never found in other species of *Cladophora*. Microchemical tests applied under the microscope show the crystals to be of proteid nature. How these crystals are formed and what part they play in the life of the cell is a matter of speculation.
A. G.

Mougeotia.—VIKTOR CZURDA ("Ein neuer, eigenartiger Kopulationsablauf bei einer *Mougeotia* (*M. cedogonioides* Czurda)," *Beih. z. Bot. Centralbl.*, 1931, 48, ii. 2, 286-90, 2 figs.). Description of the peculiar conjugation of the filaments of *Mougeotia cedogonioides* from Tibet. The zygote soon becomes walled off and disconnected from the parent cells, and is surrounded by a thick gelatinous envelope.
A. G.

Zygnemales.—VIKTOR CZURDA ("Zur Morphologie und Systematik der Zygnemen," *Beih. z. Bot. Centralbl.*, 1931, 48, ii. 2, 238-85, 17 figs.). A discussion of the various characters available for the definition of species of Zygnemales, derived from the vegetative cells and from the conjugating cells respectively. The essentials of a complete diagnosis are indicated; and a new grouping of the members of the Zygnemales is considered.
A. G.

French Siphonales.—GONTRAN HAMEL ("Chlorophycées des côtes françaises," *Rev. Algolog.*, 1931, 5, 383-430, 1 pl., 14 figs.). The Siphonales of the French coasts are here monographed, and comprise *Bryopsis* (9 spp.), *Pseudobryopsis* (1 sp.), *Derbesia* (3 spp.), *Pseudochlorodesmis* (1 sp.), *Penicillus* (1 sp.), *Udotea* (2 spp.), *Halimeda* (1 sp.), *Codium* (5 spp.), *Caulerpa* (3 spp.), *Ostreobium* (1 sp.), *Vaucheria* (6 spp.). The families, genera, and species are described, keys are provided, and many of the plants are figured.
A. G.

French Siphonocladales.—GONTRAN HAMEL ("Chlorophycées des côtes françaises," *Rev. Algolog.*, 1931, 6, 9-73, 18 figs.). A monograph of the French Siphonocladales. This order is divided into six families by Börgesen: Valoniaceæ

(*Halicystis*, *Valonia*), Boodleaceæ (*Cladophoropsis*), Anadyomenaceæ (*Microdictyon*, *Anadyomene*), Cladophoraceæ (*Cladophora*, *Rhizoclonium*, *Chatomorpha*, *Lola*, *Urospora*), Siphonocladaceæ (*Siphonocladus*), Dasycladaceæ (*Dasycladus*, *Acetabularia*, *Cymopolia*). *Siphonocladus* has not yet been found on the French coasts. The following genera are represented by one species each: *Halicystis*, *Cladophoropsis*, *Microdictyon*, *Anadyomene*, *Dasycladus*, *Acetabularia*, *Cymopolia*. *Valonia* and *Rhizoclonium* by two species each; *Chatomorpha* and *Lola* by three; and *Urospora* by four; while *Cladophora* has been treated in another paper. The Ulvales are also monographed here, and comprise five genera: *Ulva* (3 spp.), *Monostroma* (3 spp.), *Enteromorpha* (8 spp.), *Capsosiphon* (1 sp.), *Percursaria* (1 sp.). A. G.

Lemanea.—GEORGE F. ATKINSON ("Notes on the Genus *Lemanea* in North America," *Bot. Gaz.*, 1931, 92, 225-42). A posthumous paper on the American species of *Lemanea*, upon which Prof. Atkinson was at work for two years before his death in 1918. All his collected material and notes are deposited in the Cornell University herbarium. The first scientific study of the genus was Sirodot's paper in the *Annales des Sciences Naturelles*, Bot., sér. V, 16, 1-95, in 1872. The present account contains eight species and six varieties with distribution in North America and critical notes. A new species and a variety are described. A. G.

Porphyra Spores.—PIERRE DANGEARD ("Sur le développement des spores chez quelques *Porphyra*," *Travaux Cryptogamiques dédiées à Louis Mangin*, Paris, 1931, 85-96, 6 figs.). An account of some experiments in the cultivation of spore of *Porphyra*. Carpospores, the product of the fertilized egg, germinate by putting out a filamentous apparatus like a protonema; after some months one of its cells becomes charged with granular material, divides, and forms a pluricellular bud, which most probably is the beginning of a *Porphyra* frond. Asexual spores are more rare; their germination is much more rapid and direct. A. G.

Nemalion Spores.—E. CHEMIN ("Influence de la lumière sur le développement des spores de *Nemalion multifidum* J. Ag.," *Travaux Cryptogamiques dédiées à Louis Mangin*, Paris, 1931, 63-9, 2 figs.). An account of some experiments made in the cultivation of the spores of *Nemalion multifidum*; the effect of diffused light and of total darkness upon the germination of the spores is described, as also the effect of darkness followed by brief illumination. The conclusion reached is that, despite the vast output of spores, few germinate successfully. Many are killed by bright sunshine; many become covered by mud and die from lack of light. A. G.

Platysiphonia.—FREDERIK BÖRGESSEN ("Sur *Platysiphonia* nov. gen. et sur les organes mâles et femelles du *Platysiphonia miniata* (Ag.) nov. comb. (*Sarcomenia miniata* (Ag.) J. Ag.)," *Travaux Cryptogamiques dédiés à Louis Mangin*, Paris, 1931, 21-9, 5 figs.). A description of *Platysiphonia*, a new genus, based on what was previously known as *Sarcomenia miniata* J. Ag. The development of the androphores and of the procarp is described and figured from pickled material. A. G.

Ctenosiphonia.—J. FELDMANN ("Le *Ctenosiphonia hypnoides* (Welw.) Schmitz sur la Côte Basque," *Rev. Algolog.*, 1931, 5, 431-2). *Ctenosiphonia hypnoides*, a rare alga previously recorded from Lisbon, Tangier, Gijon, and Guernsey, was found by the author at Cape Figuiér, where it clothes the rocks in the zone of *Fucus platycarpus*, and grows in full sunlight, thereby differing from *Gelidium pusillum* var. *pulvinatum*, which prefers shaded rocks, vertical surfaces, or grottoes. A. G.

Galls on Florideæ.—E. CHEMIN ("Sur la présence de galles chez quelques Floridées," *Rev. Algolog.*, 1931, 5, 315–25, 1 pl., 3 figs.). The author has previously described the structure of galls found on *Cystoclonium purpurascens*; and now he gives an account of the galls found on *Gracilaria confervoides*, which he figures and describes, and shows to be due to the action of bacteria, as yet undetermined. Similar galls on *Bonnemaisonia asparagoides* were investigated, but no bacteria were found in them. A. G.

Melobesia.—MME. P. LEMOINE ("Sur l'existence dans la Manche d'une Mélobésée Méditerranéenne (*Lithophyllum* (?) *Notarisii* Duf.)," *Rev. Algolog.*, 1931, 6, 81–5, 1 fig.). An account of a *Melobesia* found at Ile de Bréhat on the north coast of Brittany far removed from its usual province along the Mediterranean coast and in North Africa. It was referred to *Goniolithon* by Foslie, but its structure is peculiar and shows it to be allied to a small group of tropical species at present included under *Lithophyllum*. A. G.

Rhodymeniales.—HARALD KYLIN ("Die Florideenordnung Rhodymeniales," *Lunds Universitets Årsskrift*, 1931, N.F. Avd. 2, 27, Nr. 11, 1–48, 20 pls., 8 figs.). A monograph of the Rhodymeniales. The family Rhodymeniaceæ is divided into three sections: (a) FAUCHEÆ, containing *Bindera* (2 species), *Gloioderma* (6), *Fauchea* (3), *Leptofauchea* (new genus, 1 species), *Faucheopsis* (new genus, 1 species); (b) RHODYMENIÆ, containing *Chrysymenia* (6), *Cryptarachne* (new genus, 3 species), *Halichrysis* Schousb. ms. (1), *Agardhinula* (1), *Erythrymenia* (3), *Erythrocolon* (1), *Calarthrum* (3), *Fryeella* (new genus, 1 species), *Botryocladia* (new genus, 8 species), *Glossosaccion* (1), *Leptosomia* (2), *Rhodymenia* (16), *Dendrymenia* (1), *Epymenia* (4); (c) HYMENOCADIÆ, containing *Hymenocladia* (11). The other family, Champiaceæ, is divided into two sections: (a) LOMENTARIÆ, containing *Lomentaria* (14); (b) CHAMPIÆ, containing *Champia* (14), *Chrysocladia* (6), *Gastroclonium* (3). Critical notes upon a number of algae of uncertain position are added, and are followed by a discussion of the affinities of the genera of Rhodymeniales. A. G.

Adriatic Algæ.—ACHILLE FORTI ("Il contributo di Maria Seibam De Cattani agli studi delle alghe marine, e di certe sue raccolte conservate a Venezia. Studi di nomenclatura," *Atti R. Istituto Veneto*, 1930, 89, 1029–40). An account of the algological work of Maria Seibam, born at Spalato in 1789, died 1870, wife of Domenico de Cattani; she collected many algæ at Zara in Dalmatia and Pago, a Croatian Island, and was in correspondence with J. G. Agardh, F. Hauck, Ardissonne, and other algologists. She appears to have issued some sets of her algæ. Two of these have been studied, and in a series of tables eighty-five of the specimens are cited under the collector's names with the modern names displayed opposite in a parallel column, and with some interspersed notes. A. G.

Algerian Algæ.—JEAN FELDMANN ("Contribution à la Flore algologique marine de l'Algérie, Les Algues de Cherchell," *Bull. Soc. Hist. Nat. de l'Afrique du Nord*, 1931, 22, 179–254, 6 pls., 8 figs.). A list of 217 marine algæ collected at Cherchell, about 60 miles west of Algiers, in the course of nine months' investigation; and another month was spent at Algiers. As a result 16 Myxophycæ, 35 Chlorophycæ, 46 Phæophycæ, and 120 Rhodophycæ, are recorded, yielding an addition of 47 species and 4 varieties to the Algerian marine flora; 7 species and a variety are new to science. Chapters are added upon the waters studied, the types of vegetation found on exposed and on sheltered rocks at various levels, in rock pools, etc., and the differences noted between the Algerian marine flora and that of the south coast of France. A. G.

Uruguay Algæ.—MARSHALL A. HOWE ("Notes on the Algæ of Uruguay," *Bull. Torrey Bot. Club*, 1931, 57 (1930), 605-10, 1 pl.). A list of twenty-two Uruguayan algæ collected by Dr. Florentino Felippone mostly in sea water. *Callithamnion Felipponei* is a new species. There appears to be no previous list in published literature. A. G.

Brazilian Algæ.—WM. RANDOLPH TAYLOR ("A Synopsis of the Marine Algæ of Brazil," *Rev. Algolog.*, 1931, 5, 279-313). An enumeration of the algæ hitherto recorded for the coast of Brazil amounting to 13 Myxophyceæ, 93 Chlorophyceæ, 60 Phæophyceæ, 195 Rhodophyceæ, and 5 of uncertain position. Such species as are open to any doubt are marked with a query. Some notes on the temperature of the waters of the South Atlantic are given. The Brazilian algal flora is of decidedly tropical character and of kin with that of the West Indies. The most active collecting has centred round Pernambuco, Bahia, and Rio de Janeiro; to the south of the last-named place there is a sharp decrease of species. Lists are given of the deep water algæ dredged off Pernambuco, Abrolhos Islands, and Cabo Frio. The list is intended as a preliminary catalogue; the material of the older authors needs to be re-examined in the light of modern knowledge. A. G.

Japanese Algæ.—YUKIO YAMADA ("Notes on Some Marine Algæ from Yokoska (Japan) determined by Dr. Hariot," *Rev. Algolog.*, 1931, 6, 1-7). A series of critical notes upon the algæ collected at Yokoska by Savatier, sent to P. Hariot of the Paris Museum for determination, and published in *Mem. Soc. Sci. Nat. Cherbourg*, 1891. A. G.

Fungi.

Phytophthora on Leeks.—C. E. FORSTER ("The White Tip Disease of Leeks and its Causal Fungus, *Phytophthora Porri* n.sp.," *Trans. & Proc. Bot. Soc. Edin.*, 1931, 30, 257-81, 3 text-figs., 1 pl.). This disease has of late become of importance; it has been characterized by growers as "White Tip." Examination has shown it to be due to the fungus *Phytophthora Porri* n.sp. The symptoms of the attack are as the name indicates—the discoloration of the leaf-tips and the presence of water-bogged areas in the tissues. The parasite, it has been found, grows saprophytically in the soil, produces conidia in the open, and these are evidently blown on to the leaves of the leek. The fungus has been thoroughly examined and described, and also contrasted with other known species such as *Ph. infestans*. The relations of growth to temperature, medium, etc., are discussed. A. L. S.

Cytological Study of *Synchytrium endobioticum*.—E. KÖHLER ("Zur Biologie und Cytologie von *Synchytrium endobioticum* (Schilb.) Perc.," *Phytolog. Zeitschr.*, 1931, 4, 43-55, 17 text-figs.). In this study of Potato wart-disease, Köhler gives a detailed account of the copulation of the gametes, as observed by him under the microscope. In a drop of water the gametes, potentially male or female, congregated in groups; more than two may be fused to form the zygote. During this time the intrusion of a speck of vaseline into the drop was sufficient to stop the process by scattering the group, and the male gametes were changed to female. Normally only two gametes fused, their cilia disappeared and they became surrounded by a plasma membrane. The zygotes pierce the potatoes and enter the cells. It is supposed that some attractive substance draws them to the potato surface. The writer describes, as far as could be observed, the nuclear fusion within the zygote, the further behaviour within the plant cell, and the growth in size of the invading zygote, with the division that followed. A. L. S.

Notes on Peronospora.—C. HAMMARLUND ("Kleinere Mycologische Notizen II," *Bot. Not.*, 1931, 5, 329–3). Hammerlund has given a description of an unusually large *Peronospora Brassicæ* specimen on *Raphanus sativus* f. *radicula*. It grew on leaves, leaf-stalks, and flowers. When it occurred on the tubers that had emerged above the soil, it reached unusual proportions—the conidiophores a height of 7–800 μ , and the conidia also larger than usual, on leaves the sizes were equally large. Oospores were abundant and of normal size. The author, however, sees no reason to question its affinity with *P. Brassicæ*. A. L. S.

Study of Sorodiscus.—W. R. IVIMEY COOK ("The Life-History of *Sorodiscus radicolus* n.sp.," *Ann. Mycol.*, 1931, 29, 313–24, 2 pls., 2 text-figs.). This organism, a member of the Plasmodiophoraceæ, was found causing tumours on the roots of *Gynandropsis pentaphylla* in S. Africa, collected by Dr. E. M. Doidge. The earliest stage was a small uninucleate plasmodium; as growth continued the nuclei increased, but not to any large size; the nuclei and the method of division have been described as well as further characteristics of development which agree with *Sorodiscus*. It differs from other species of that genus in the spore balls, with the number and size of the spores. The new species is fully described. A. L. S.

Study of Sporodinia.—R. E. D. BAKER ("Observations on the Conditions for Spore Formation in *Sporodinia grandis* Linbr.," *New Phytologist*, 1931, 303–16). The author has made cultural studies of spore formation in this fungus in order to examine the external conditions that influence reproduction, especially temperature, humidity, and the nature of the medium. Low temperatures he found were more favourable to the formation both of sporangia and zygospores, though both grew in a wide range of cold or heat. Humidity had no marked effect. The composition of the media was important in determining whether sporangia or zygospores would be formed; the concentration of the medium, low in carbohydrate but high in the nitrogenous constituent, resulted in the formation of zygospores. Thus, it has been proved that concentration as well as composition of the medium is important. A. L. S.

Study of Monascus.—ELAINE M. YOUNG ("The Morphology and Cytology of *Monascus ruber*," *Amer. Journ. Bot.*, 1931, 18, 499–517, 3 pls.). Considerable attention has been paid to the development and systematic position of this somewhat obscure fungus. It is now considered to be an Ascomycete in the family Aspergillaceæ. Young has worked out by means of cultures the stages in mycelium formation and the development of the fruiting bodies. An early fusion of antheridium and trichogyne, which arise from the same hypha, has been followed; nuclear migration occurs from the male to the female organ and through the trichogyne into the ascogonium. From the ascogonium arise the ascogenous hyphæ which become septate, the terminal second or third cells may form asci. The division of the nuclei and formation of spores are described; the ascus walls finally degenerate leaving the ascospores free in the perithecial cavity. A. L. S.

The Asterineæ.—G. ARNAUD ("Les Asterinées.—VII.," *Ann. Crypt. Exot.*, 1931, 4, 74–97, 6 pls.). Arnaud states that little attention has been paid to these groups of fungi which are very numerous in the French Colonies. In the first part of the paper, devoted to classification, he arranges the different tribes. Under the heading Polystommellées Wardinées he places the two more truly asterine genera *Halbanina* Arn. and *Asterina* Lér., and has given an account of them. The genera represented on the plates are: *Maurodothella*, *Seynesiopeltes*, *Myiocopron*, *Polystomella*, *Halbanina*, and *Asterina*. A. L. S.

Helvella pulla.—E. ULBRICH (" *Helvella pulla* Holmsk (*H. Klotzschiana* Corda) aus Schlesien," *Notizbl. Bot. Gart. und Mus. zu Berlin-Dahlem*, 1931, 11, 248-51). This somewhat rare fungus has recently been found in Silesia, and Ulbrich takes occasion to describe it and to compare it with allied species. It attains a height of about 10-18 mm.; the head is dark brown, and the base of the Silesian specimen was covered with a floccose mycelium determined as *Hypochnus cervinus* similar to what is found on other *Helvellæ*. By a comparative study *H. Klotzschiana* has been recognized as a synonym, the variations between the species being an effect of age, etc.

A. L. S.

Notes on Hypoxylon Species. I.—JULIAN H. MILLER (*Ann. Crypt. Exot.*, 1931, 4, 72-3, 1 pl.). Miller has written these notes in order to clear up the confusion that has arisen over the annulate group of Hypoxylons; that is, of *H. stygium* and its associates now reckoned as synonyms. The stroma originates as a thin reddish-brown layer becoming at maturity hard, carbonaceous, and shining black.

A. L. S.

Study of Pleospora.—M. ELLIS ("Some Experimental Studies on *Pleospora herbarum* (Pers.) Rabenh.," *Trans. Brit. Mycol. Soc.*, 1931, 16, 102-14, 1 pl.): The fungus was taken from plants of *Euphorbia Paralias*, but is common on many other plants. The growth and fructification were carefully followed on artificial media of varying ingredients, the response of the fungus to these media was carefully noted. It was found that nitrogen content was of less importance than carbon. Carbon controls the pigmentation, and to a large extent the formation of primordial mycelia. The richer the media the more perithecia are formed, but there are fewer in an acid medium. Zonation is pronounced in this fungus, and is caused by alternations of temperature. Saltation occurred in the cultures as a white non-fertile strain either in sectors or in small tufts; this strain retains its character in cultures.

A. L. S.

Sex in Ascobolus.—E. SILVER DOWDING ("The Sexuality of *Ascobolus stercorarius* and the Transportation of the Oidia by Mites and Flies," *Ann. Bot.*, 1931, 45, 621-37, 1 pl., 10 text-figs.). The oidia of this fungus were first observed by Claussen in the form of chains produced on the mycelium derived from an ascospore. He cultivated them for many generations without securing any apothecia. In this study Silver Dowding has given the results of culturing oidia from different sources. Two days after pairing the resulting mycelia had fused to form a netted compound mycelium on which finally fruit-bodies were formed. It has been thus proved that the ascospores and also the oidia are unisexual, and only by pairing $a +$ and $a -$ body can there be fruit production. She has also proved by observation that mites and flies creeping over the *Ascobolus* transport ascospores and oidia to those of an opposite sex, possibly wind may also aid in the distribution.

A. L. S.

Sexuality in Yeasts.—A. GUILLIERMOND ("Recherches sur l'Homothallisme chez les Levures," *Rev. Gén. Bot.*, 1931, 43, 49-86, 6 pls., 10 text-figs.). In yeasts there is copulation between cells previous to ascus formation. The author has made a series of observations on the nature of the fusion cells. He concludes that these two cells are homothallic, and that fusion takes place generally between cells from the same origin in the ascus, either immediately after formation or after successive divisions. In *Saccharomyces Ludwigi*, however, he finds that the four nuclei in the ascus may be two $+$ and two $-$; they fuse within the ascus itself, and that may indicate some heterothallism.

A. L. S.

Nuclear Division in the Ascus.—M. et MME. F. MOREAU ("Existe-t-il une double réduction chromatique chez les Ascomycètes," *Rev. Gén. Bot.*, 1931, 43, 465-73, 3 pls.). After a renewed study of this much debated question the authors have restated their view that there is no double fusion and no double reduction division in the ascus—thus they believe that they have substantiated by a careful enumeration of the chromosomes—eight double chromosomes in the first ascus division, thereafter eight single chromosomes (in *Aleuria vesiculosa* and *Helvella crispa*). As to *Pyronema confluens* they contend that there are twelve haploid chromosomes in the nuclei of the ascus in that species, and that there has not been double fusion during the life history. A. L. S.

Temperature and Fusarium Infection.—JEAN DUFRENOY et MELLE TH. FRÉMONT ("Influence de la température sur les réactions du maïs à l'infection fusarienne," *Phytopath. Zeitschr.*, 1931, 4, 36-41, 5 text-figs.). This research has reference to the plant changes that occur at low temperatures, and the effect on parasitic infection. On the remains of diseased Maize plants the writers were able to determine *Fusarium graminearum*. Growing plants were infected and their tissues examined. They found that phenol compounds were not present in infected or neighbouring cells, while in healthy cells these compounds were easily detected; they concluded that the presence of phenol was an important protective agent. They have further proved that these compounds were naturally formed at high temperatures and were absent at low temperatures, thus exposing the cells to the entrance of the fungus hyphae. A. L. S.

Saltation in Stemphylium.—MARGARET A. BRETT ("Cyclic Saltation in *Stemphylium*," *Brit. Mycol. Soc.*, 1931, 16, 89-101, 1 pl., 4 text-figs.). The author of this paper has had *Stemphylium* under culture observation for two years. It was noted that on dilute media, while the plate was mainly occupied by a feebly sporulating mycelium, there were also formed bands where dense heads of spores were produced. Cultures from the feebly sporing areas gave rise to slow growing colonies in which chains of spores of *Alternaria* type occurred. Sub-cultures from these have given rise to occasional *Alternaria* forms, while renewed cultures have produced colonies of spore-chains (*Alternaria*) though *Stemphylium* spores also occur in every generation. In capacity for germination and rate of germinating the other spores from densely sporing mycelium are the more inferior product. A. L. S.

Study of Helminthosporium.—M. MITRA ("Saltation in the Genus *Helminthosporium*," *Trans. Brit. Mycol. Soc.*, 1931, 16, 115-27, 1 pl., 3 text-figs.). Cultures of eight forms or species of *Helminthosporium* collected in India were undertaken by Mitra at the Imperial Institute. New strains arose during the course of the cultures as sectors or as colonies (isolated patches). From both types saltants were procured by culture. The changes inherent in these saltants are: (a) Macroscopic characters, intensity of sporulation, etc., but so variable that no taxonomic value can be ascribed to them. (b) Microscopic variation in dimension and septation of spores, shape, and colour being fairly constant. (c) A considerable range of parasitic vigour in saltants of the species *H. sativum*. A full account is given of methods and of the effect of varying media and of temperature. Mitra records forty-eight distinct strains resulting from his cultures—these all differed more or less from the parent forms. A. L. S.

Study of Rust Infection.—JAKOB ERIKSSON ("Phytopathologische Mitteilungen II.," *Arkiv. för Bot.*, 1931, 23, 1-18, 6 pls., 4 text-figs.). Eriksson discusses two types of rust growth in this paper. (1) The growth of the hypha after

inoculation in *Puccinia Malvacearum*. He follows the development of the germination hypha into the cells of the host plant; he indicates also the influence of the invading fungus on the contents of neighbouring cells resulting in the conjunction of cell plasma and fungus to form a mycoplasma. He finds the same mycoplasma formation in the cells of *Ribes* spp. invaded by *Puccinia Ribis*. Eriksson kept branches of the *Ribes* under observation during the winter and noted the growth of a new branchlet thickly covered with pustules of the rust. He finds that the infection in this case must here be due to an inner mycoplasma, the symbiotic union of the protoplasm of the cell and the fungus plasma of the parasite, and that the cells of the *Ribes* branch was full of this substance.

A. L. S.

Study of Rust Infection.—G. GASZNER and W. STRAIB ("Zur Frage des Infektionstypus von *Puccinia tritici* Erikss.," *Physiol. Zeitsch.*, 1931, 4, 57–63, 1 pl.). *Puccinia tritici* was considered to be constant in its power of infecting wheat with rust disease. The authors by various experiments have proved that it is subject to the influence of temperature. They have proved that certain wheats considered as entirely resistant may be infected by rusts in low temperatures, and that among wheats of variable infective character there may be kinds that resist the disease even at low temperatures.

A. L. S.

Overwintering of Melampsora.—PIERO SCARAMELLA ("Sullo svernamento delle *Melampsora* dei *Salici* in alta montagna," *Nuovo Giorn. Bot. Ital.*, 1931, 38, 538–40). Scaramella reports his observations on the renewal of rust growth on willows which were all infected year after year by the same *Melampsora*. He has concluded that the mycelium overwinters on the branches, and reappears on the leaves.

A. L. S.

Sexuality in Rusts.—J. H. CRAIGIE ("An Experimental Investigation of Sex in the Rust Fungi," *Phytopathology*, 1931, 21, 1001–40, 14 text-figs.). The author has given here a complete account of his investigation as to the function in rusts of the pycnia and as to the development of æcidia. He states the problems to be solved, and the attempts of previous workers to discover the interrelation in rusts of the different stages of development. He then proceeds to describe his methods of work—the instruments, and the manipulation of his tools, and finally gives the successful results which have cleared up the life-history and the important part played by the seemingly useless pycnia. He experimented at first with *Puccinia graminis*, later with *P. Helianthi*, and he was successful in proving that the teleutospores give rise to sporidia of different sex. These germinate on the host-leaf and give rise to pustules either + or —, that is, of two different sexes. The pustules, or pycnia, produce sporidia involved in nectar, and a union between those of two pustules (+ and —) takes place by close association on the leaf or by the action of mites, etc., distributing the sporidia. Where the resulting fusion takes place æcidia are developed. Various other aspects of the question are also dealt with; and there is a very complete list of literature.

A. L. S.

Monosporidial Culture of Rusts.—DOROTHY ASHWORTH ("*Puccinia Malvacearum* in Monosporidial Culture," *Trans. Brit. Mycol. Soc.*, 1931, 16, 177–202, 2 pls., 7 text-figs.). This rust is "short-cycled" without pycnidiospores in the life-cycle. The host plants *Malva* and *Althæa* were successfully infected by sporidia, and the whole process of further development has been followed by the author—the inoculations were made both with one and with a number of sporidia, the time taken by the fungus to develop varied with the temperature. The sporidium was observed to secure entrance to the host-cell by a fine penetration hypha at the tip

of a germ tube. This primary infection hypha becomes septate, forming four uninucleate cells, each of which puts out a hypha that gives origin to the vegetative mycelium. From the mass of mycelium formed, certain branches are formed with club-shaped end cells; the change to the diplophase condition is effected at this stage by nuclear division or by nuclear migration, and arises more than once in a sorus. Each binucleate cell divides into a stalk cell and an upper cell which, by division, forms the two-celled teleutospore. On germination of these spores a promycelium is formed, and a return is made to the haplophase stage. A. L. S.

Study of Uromyces.—ERNST GÄUMANN ("Über die Biologie des *Uromyces Rumicis*—I.," *Ann. Mycol.*, 1931, 29, 399-405). Gäumann has made a cultural study of *Uromyces* on *Rumex*; there has been confusion between two species, *U. Rumicis* and *U. Acetosæ*, now proved to be distinct; the former showed greater difference in its parasitism of the host plants, while *U. Acetosæ* invariably infected strongly the four host species that were tested: *Rumex arifolius*, *R. myrtiliflorus*, *R. Acetosa*, and *R. Acetosella*. A large number of different *Rumex* species were infected more or less by *U. Rumicis*. A. L. S.

Tilletia Triticis on Ægilops.—I. REICHERT (*Trans. Brit. Mycol. Soc.*, 1931, 16, 133-35). Reichert gives an account of infection experiments with *Tilletia Triticis*, the bunt of wheat. A similar experiment by Vavilov had resulted in the infection of two species of the genus, a third *Æ. ovata* being unaffected. Reichert's infected seeds of nineteen species of *Ægilops* including the three used by Vavilov, with the result that only *Æ. ventricosa* took the disease. The method employed was to de-hull the seeds and shake them in a container with bunt spores. The seeds were sown and watered with results given above. A. L. S.

New Entyloma.—TR. SĂVULESCU ("Ein neues *Entyloma*, *Entyloma Leontivus* Săvul.," *Ann. Mycol.*, 1931, 29, 398). Săvulescu notes that this member of the Ustilaginæ is the first to have been observed on a species of Berberidaceæ, *Leontice aliaica*. It was found in Roumania, and was characterized by the round or ellipsoid spots of a brown colour on the leaves. A diagnosis of the new species is given. A. L. S.

Study of Uromyces.—S. L. AJREKAR and S. A. PARANDEKAR ("Observations on the Life History of the Rust Fungus *Uromyces* species on *Jasminum malabaricum* and its relation to *Uromyces Hobsoni* Vize on *Jasminum grandiflorum*," *Journ. Ind. Bot. Soc.*, 1931, 10, 195-204, 2 pls.). By culture studies which are described at length the authors of the paper have been able to prove that the *Uredo* on *Jasminum malabaricum* is unrelated to the *Uromyces* on the same host. Another species, *Uromyces Hobsoni* Vize, is also found on *Jasminum malabaricum* and on *J. grandiflorum*; it produces æcidia, teleutosori, and these are described, but are unconnected with the other *Uredo*, a rust-fungus that occurs in the uredo stage alone. A. L. S.

Über Chrysomyxa Ramischia Lagerh.—E. ULBRICH (*Notizbl. Bot. Gart. und Mus. zu Berlin-Dahlem*, 1931, 11, 254-61). Ulbrich publishes critical notes on this somewhat rare northern fungus recently found in the sea-coast of Pomerania, on plants of *Ramischia*. A full account is given of their occurrence in other lands, more especially in Alpine and Arctic localities, where it is usually found. A. L. S.

Study of Smuts.—WERNER HÜTTIG ("Über den Einfluss der Temperatur auf die Keimung und Geschlechtverteilung bei Brandpilzen," *Zeitschrift für Botanik*, 1931, 24, 529-77, 26 text-figs.). The author gives a general sketch of what is

known about spore germination and cytology, and then describes his research methods and gives an account of germination as observed by himself. The temperature—the main object of the research—was constantly observed from 1° to 35° C. For *Ustilago Avenae* the highest percentage of germination, 98 p.c., was at 20°, for *U. Hordei* the highest, 99 p.c., was at 10°. Germinations of other species are also recorded, and these results are compared and criticized. The results observed as regards nuclear division in all stages are set forth; the diploid nucleus passes from the spore into the promycelium, two divisions give a four-celled mycelium. The view that a reduction division took place in the first division is not always correct. Hüttig has found that it depends largely on temperature. The reduced nucleus possesses two chromosomes. A long list of literature bearing on the subject follows.

A. L. S.

Critical Notes on Agarics.—P. KONRAD ("Notes critiques sur quelques champignons du Jura," *Bull. Soc. Mycol. France*, 1931, 47, 129-48). The author publishes a revision of nomenclature and descriptions of a number of well-known Agarics belonging to the genera *Collybia*, *Mycena*, *Tricholoma*, and *Clitocybe*, with complete diagnoses, and with biological notes and justification for the changes in determination.

A. L. S.

Notes on *Russula chameleontina*.—JAROSLAV ZVARA ("A propos de *Russula chameleontina* Fries," *tom. cit.*, 149-56, 2 col. pls.). The author finds that two different species of *Russula* are included under the above name. He gives the records in literature, and he has also provided critical descriptions, and has discussed the synonymy of the species.

A. L. S.

Notes on *Marasmius*.—JULES FAVRE ("Le marasme du houx, *Marasmius* (*Androsaceus*) *Hudsoni*," *Schweiz. Zeitsch. Pilzkunde*, 1931, 9, 133-44, 1 text-fig.). The whole publication discusses various aspects of fungus study and fungus collecting. Jules Favre gives special notes (136-7) on the *Marasmius* of holly, *M. Hudsoni*, easily recognized by the cystidia, rather stiff and brown coloured hairs that occur on stem and pileus. It is a winter or late autumn minute species, and rather rare in Switzerland. Favre also contributes notes on the Ivy *Marasmius* (137-8), *M. (Androsaceus) epiphylloides*, rather common in winter in the Haute Savoie.

A. L. S.

New Member of Corticiæ.—VIKTOR LITSCHAUER ("*Gloeocystidium Sernanderi* Litsch., eine neue Schwedische Corticiæ," *Svensk. Bot. Tidsk.*, 1931, 25, 435-7, 1 text-fig.). The new fungus was formed on decaying trunks of deciduous trees—*Betula*, *Fagi*, and *Quercus*—as also on trunks of *Picea excelsa*. It has been examined and described by the author. The basidium is provided with four spores; the hyphæ have also distinctive characters.

A. L. S.

New Genus of Rhizopogonaceæ.—CARROLL W. DODGE ("*Alpova*, a new Genus of Rhizopogonaceæ, with Further Notes on *Leucogaster* and *Arcangeliella*," *Ann. Miss. Bot. Gard.*, 1931, 18, 457-63, 1 pl.). The fungus described, a Gasteromycete, was found by A. Povah at Isle Royal, Lake Superior. Dodge outlines the evolutionary history of the gasteromycetes, noting characters that are primitive as regards peridium, gleba, spores, etc. The new genus *Alpova*, though mainly primitive, shows characters that are advanced, as, for instance, the pseudoparenchymatous peridium; the spores are small, ellipsoid, and brownish in the mass. The specimens were half buried in soil. Dodge adds notes of his study of type specimens of *Leucogaster* and *Arcangeliella* in European Herbaria.

A. L. S.

Polyporaceæ of Colorado.—PAUL FRANKLIN SHOPE (*Ann. Miss. Bot. Gard.*, 1931, 18, 287–408, 39 pls.). In the introduction Shope describes the ecology of the district explored, with a division into zones: the Plains, Foothill zone, Montarie zone (up to 10,000 feet), the subalpine zone, and the Alpine zone, the latter above 11,500 feet, or above timber-line, where few fungi are found. He gives the physical conditions of each of the zones; the two extreme zones are poorest in pore fungi. Many other data are recorded—the species of coniferous and deciduous plants, with the prevailing temperature and moisture. There follows an account of Polyporaceæ with a classification of the family, nine genera in all. Synoptic tables are provided for each subdivision and, finally, a complete account of each species with its synonymy. All the species are figured on the fine plates of photographic reproductions, and there is a full index to all the names mentioned in the text.
A. L. S.

Soil Fungi in Colorado.—E. L. LE CLERG (“Distribution of Certain Fungi in Colorado Soils,” *Phytopathology*, 1931, 21, 1073–81). The fungus content of thirteen soils of different physical conditions and supporting different crops was examined by Le Clerg. He determined thirty-one fungus species, which he lists under the many kinds of soil: sugar-beet soils, garden soils, corn-producing soils, alkali soils, subsurface, wind-blown, and cultivated soils. Alkali soils he found tended to show a reduced fungus flora, though *Fusarium* spp. were abundant there as everywhere else. Fungi were more numerous in cultivated soils, and their number was greatest in soils producing red clover. “Species of *Aspergillus* and *Penicillium* outnumbered all the other fungi isolated.” It was also noted that fungi were more scarce in deeper soils; *Alsidia spinosa* and *Fusarium* spp., however, were isolated at a depth of 6 feet, in the “subsurface” soils.
A. L. S.

Evolution in Fungi.—W. B. BRIERLEY (“Biological Races in Fungi and their Significance in Evolution,” *Ann. Appl. Biology*, 1931, 18, 420–34). The occurrence of biological races in fungi is now generally recognized. Frequently there may, however, be no morphological difference; the races very frequently distinguished only by their parasitic relation to the host-plant. Brierley has followed in successive cultures of *Botrytis cinerea* the changes due to different culture media. From the isolate (the first culture from a single spore) he indicates the origin of groups constituting a strain or race (Lotsy’s “Jordanon”), and within these races there may be physiological forms. The groupings of these various forms is next discussed. He looks on the Herbarium species type as merely a single phenotype of the races that compose the species. He believes that many similar races, deemed species, occur in Hymenomycetes as, for example, in *Armillaria* and *Russula*, in Ascomycetes, in Phycmycetes, and more especially in Fungi Imperfecti. He then passes on to discuss mutation—a “discontinuous variation” occurring in single spore cultures where, owing to genetic contamination, there may be an impure culture giving rise to impurities. Variation may also arise from hyphal fusions of a somatic nature which are of common occurrence. In his cultures of *Botrytis cinerea* he found no variation of specific rank. He concludes with a survey of possible evolutionary lines of development in fungi (as exemplified in the long continued culture of *Botrytis*) through grouping of “races” and physiological forms.
A. L. S.

Cryptogamic Flora.—M. MAURY (“Florule cryptogamique de la Champagne crayeuse (Myxomycètes, Siphomycètes, Uredinées et Ustilaginées),” *Bull. Soc. Mycol. France*, 1931, 47, 157–99). Maury has listed a large number of microfungi under the above orders, with an additional order Chytridiaceæ. The order

Mycomycètes includes *Plasmodiophora* and *Sorosphaera* as well as the Mycetozoa. He points out the difficulty in collecting Chytridiaceæ in that the host plant shows little evidence of attack, or the fungi may even be underground. The number of species—chiefly of *Cladochytrium*—is considerable. Under the order Siphomycètes are numbered Peronosporaceæ, Mucorini, and Entomophthoraceæ. Finally, as Basidiomycètes, he has listed Pucciniaceæ and Ustilaginæ. In each group are found a number of species; locality and habitat are described. A. L. S.

Micromycetes.—T. RAYSS ("Contribution à la connaissance des micromycètes aux environs de Besse (Puy-de-Dôme)," *Bull. Soc. Mycol. France*, 1931, 47, 200–20, 3 text-figs.). Rayss has made an important contribution to the knowledge of micromycetes in a region where the Biological Station of Besse gave every facility for laboratory examination of specimens. He gave special attention to *Peronospora*, giving microscopic details of the twenty-four species found by him during his sojourn. The wet, cold summer of 1930 had been favourable to the growth of the parasites. He determined a new species of Sphærospideæ *Diplodia Mangini*, on leaves of *Vicia Orobus*. Many Uredinæ are recorded, and a critical note on *Puccinia Epilobii-tetragoni* Wint. is given with a table of the spore measurements by six different mycologists. He includes *Puccinia pulverulenta* Grev. as a synonym. In all seventy-three species belonging to twenty-seven genera were found and determined. A. L. S.

Colouring Matter of Penicilliopsis.—ADALBERT BLOCHWITZ ("Der Farbstoff der *Penicilliopsis* Solms-Laubach," *Ber. Deutsch. Bot. Gesell.*, 1931, 49, 319–23). Blochwitz found in this fungus that the colouring matter could be extracted by ether though not by alcohol, and gave a red reaction with potash. He gives notes on the effect of using chloroform and benzine. He comments on the dye reaction on silk and wool, and suggests that their strands contain substances that can associate with certain salts. A. L. S.

Fungi on Pandanus.—ONORATO VERONA ("Nuovi Micromiceti su Pandanaceæ," *Nuovo Giorn. Bot. Ital.*, 1931, 38, 534–37, 3 text-figs.). The fungi *Phomatospora Pandani* n.sp. and *Phoma Pandani* n.sp. were found on leaves of *Pandanus pedunculatus* var. from Queensland, Australia. The leaves were dead, and neither fungus can be classed as parasitic. Full descriptions and figures are given, and also a considerable list of fungi known to occur on Pandanaceæ. Another species, *Macrophoma Pandani* Berl. & Vogl., was found on the fruits of *Pandanus odoratissimus*. A. L. S.

Mycelial Infection of Liliaceæ.—CARLO CAPPELLETTI ("Sulla presenza di miceli nel tegumenti seminali di alcune liliaceæ e particolarmente nel genere *Tulipa*," *Nuovo Giorn. Bot. Ital.*, 1931, 38, 479–508, 5 text-figs.). Cappelletti gives the results of seed infection by the mycelium of various fungi in the Liliaceæ. He describes the process of infection on the parts of the seed attached by the fungus. It was observed that though the outer teguments of the seed were invaded the embryo remained intact, as also the reserve of endosperm. Attention was paid to the fungi represented: *Sclerotium Tulipæ*, *Penicillium*, *Aspergillus*, *Mucor*, etc. A new species, *Mycogone Tulipæ*, was isolated. The growth of the invading fungus was slow, and in view of its slow development and the slight influence on the life of the plant, the infection seems to represent a new "type" or aspect of fungus growth. A. L. S.

Medical Mycology.—RHODA W. BENHAM (*Phoma conidiogena*, an Excitant of Asthma: Some Observations on the Development and Cultural Characteristics,"

Bull. Torr. Bot. Club, 1931, **58**, 203-4, 3 pls., 19 text-figs.). The fungus was obtained during the investigation of a case of asthma due to a fungus. Cultures were made, and the growth of fungus, the reaction to different media, and the development of the fruiting bodies are described. A pycnidium was found, and the fungus was identified as *Phoma conidiogena* Schnegg. In culture a hyphomycetous stage, *Alternaria*, was also developed. A. L. S.

Medical Fungus.—H. CHAUDHURI ("Note on a *Cordyceps* from Tibet," *Trans. Brit. Mycol. Soc.*, 1931, **16**, 203-4, 3 text-figs.). Chaudhuri records the reception of a packet of *Cordyceps* (*C. sinensis*) from Eastern Tibet, used as a tonic by the Tibetans and the Chinese. Chaudhuri gives a description of the fungus which is known as the "Chinese Plant Worm." A note with a photograph by J. Ramsbottom is added on the same fungus, bundles of which were sent to the Botanical Department, British Museum, from Szechwan, N. China. A. L. S.

New or Noteworthy Fungi.—Part XII.—W. B. GROVE (*Journ. Bot.*, 1932, **70**, 1-7, 1 pl.). A number of microfungi new to Britain are here fully described and classified. A new genus, *Dictyothyrium*, a member of the Leptostromataceæ, has been described with the species *D. Betulæ*. All of the species described belong to the order Sphærospideæ. A. L. S.

Mycological Contributions.—F. PETRAK ("Mykologische Notizen," XI, *Ann. Mycol.*, 1931, **29**, 338-97). Petrak reviews a large number of fungi mostly from Bulgaria; many of them are new species, but mainly they are species considered by Petrak as placed in wrong genera. All are microfungi, either saprophytic or parasitic. The descriptions and notes are very full. A. L. S.

Study of Hyphal Vacuoles.—YVONNE CASSAIGNE ("Origine et evolution du vacuome chez quelques champignons," *Rev. Gén. Bot.*, 1931, **43**, 140-62). After an historical account of the study of vacuoles in fungi, especially as to their origin, the author gives the results of her own observations—chiefly on the formation and movement of vacuoles in *Saprolegnia* and yeasts. She has concluded that their formation and their changes of position and form are due to the water content and movement of the cytoplasm in the cell. Her conclusions agree with those suggested by Guilliermond that vacuoles may arise at any time, and are the result of changes in the protoplasm. A. L. S.

Cotton Disease.—J. C. F. HOPKINS (" *Alternaria gossypina* (Thün.) comb. nov. Causing a Leaf Spot and Boll Rot of Cotton," *Trans. Brit. Mycol. Soc.*, 1931, **16**, 136-44, 1 pl., 7 text-figs.). Hopkins describes the disease as it appears on the early leaves of Cotton in Rhodesia. An *Alternaria* develops and, at a later stage, a *Phyllosticta* has been observed. Finally, it has been determined as *Alternaria gossypina* (Thün.) comb. nov., and has been identified in microscopic characters with *Alternaria macrospora*, a similar disease in Nigeria and in Trinidad. A. L. S.

Elm Tree Diseases.—CHRISTINE BUISMAN ("Three Species of *Botryodiplodia* (Sacc.) on Elm Trees in the United States," *Journ. Arn. Arbor. Harvard Univ.*, 1931, **12**, 289-96, 2 pls., 1 text-fig.). In the course of her researches on the European Elm Disease, the author paid attention also to Elm "die-back" diseases in America. From cankers caused by such diseases she isolated three different fungi, namely, *Botryodiplodia malorum*, *B. ulmicola*, and *B. hypodermia*. She successfully inoculated saplings with the spores, and in each case reproduced the fungus, though *B. hypodermia* was the only one that finally formed cankers. A. L. S.

Carrot Disease.—GEORGE F. WEBER ("Blight of Carrots caused by *Sclerotium Rolfsii*, with Geographic Distribution and Host Range of the Fungus," *Phytopathology*, 1931, **21**, 1128-40, 6 text-figs.). The disease shows itself by a yellowing of the old leaves, and was diagnosed as *Sclerotium Rolfsii*, a well-known and widespread parasite; the author gives a list of 189 host-plants of the fungus, though it has not hitherto been reported on carrot. It mostly occurs in southern or tropical localities. An account is given of inoculation, and other tests to authenticate the parasite.
A. L. S.

Disease of Cotton Plants.—WALTER N. EZEKIEL and J. J. TAUBENHAUS ("A Disease of Young Cotton Plants caused by *Sclerotium Rolfsii*," *tom. cit.*, 1191-94, 1 text-fig.). The incidence of the disease due to the *Sclerotium* has been reported previously, but the occurrence of the parasite on cotton is now proved by cultural methods and by artificial inoculation.
A. L. S.

Seed-Borne Diseases.—N. L. ALCOCK ("Notes on Common Diseases sometimes Seed-Borne," *Trans. & Proc. Roy. Soc. Edinb.*, 1931, **30**, 332-37). A comprehensive list of economic plants, the seeds of which require careful attention as they are disease carriers; they are mainly the seeds of common farm food-plants, such as turnips and beets, beans, peas, and a series of forage crops. Flax and a few flowers are included; the transportable disease is also added, and the district.
A. L. S.

Fungus Diseases.—N. L. ALCOCK ("List of Fungous Diseases," *tom. cit.*, 338-50). There are here listed the diseases on plants due to fungi that have been sent in for consultation and advice to the Pathological Department of Department of Agriculture for Scotland. The host-plants are largely economic, including many kinds of farm or garden produce. There are also a fair number of parasites on flowers, and on conifers, as well as on deciduous trees. The locality for each occurrence of disease is given.
A. L. S.

Apple-Rot Fungi.—GEORGE D. RUEHLE ("New Apple-Rot Fungi from Washington," *Phytopathology*, 1931, **21**, 1141-52, 4 text-figs.). This is a report of fungi found growing on and causing decay of apples in cold storage at Washington. The author gives a long list of these fungi belonging to Phycomycetes and Ascomycetes, but mostly to Fungi Imperfecti; in the latter group four species new to science have been described.
A. L. S.

Blight of Bladder Nut.—W. H. DAVIS ("Corynose Twig Blight of the American Bladder Nut, *Staphylea trifolia*," *tom. cit.*, 1163-71, 1 text-fig.). The disease of *Staphylea* has been traced to the parasitism of a member of the Sphærospidiæ, *Coryneum microstictum* var. *Staphyleæ* var. nov. The young twigs are chiefly affected; in one case a third of the current year's growth succumbed to the disease. The author has proved the parasitic nature of the organism by cultures, inoculation, etc. Inoculation experiments showed that infections "occurred at the nodes and tips of the meristematic tissue during the spring." The acervuli pass the winter on the dead twigs, and the spores are disseminated in spring.
A. L. S.

Fig Blight.—J. J. TAUBENHAUS and WALTER N. EZEKIEL ("A *Sclerotinia* Blight of Figs," *tom. cit.* 1931, 1195-97, 1 text-fig.). The disease appeared as a sudden wilting of the foliage, followed by the dying of the branches affected. Search in the neighbourhood resulted in finding sclerotia among the dead foliage. Cultural and infection experiments proved the affinity of the fungus to *Sclerotinia*.

sclerotiorum; and infection was passed on by the ascospores discharged from the apothecia near infected trees. No trace of the presence of *Botrytis* was found.

A. L. S.

Anthraxnose of the Jujube.—J. J. TAUBENHAUS and WALTER N. EZEKIEL (*tom. cit.*, 1185–89, 2 text-figs.). The disease was found on *Zizyphus jujuba* in Texas. The first symptom noticed was the premature shedding of the fruits. These were examined, and outside and inside a fungus was found. Culture experiments and inoculations were carried out, and the anthraxnose was determined as a *Glomerella*—possibly a stage in the life-history of *Glomerella cingulata*.

A. L. S.

Plant Diseases in Peru.—E. V. ABBOTT ("Further Notes on Plant Diseases in Peru," *Phytopathology*, 1931, 21, 1061–71). The writer gives special attention to the more important crops, such as sugar-cane, cotton, cereals, and potatoes, and he has recounted the more serious disease attacks. On sugar-cane, mosaic causes much damage. Cotton is attacked by *Fusarium* wilt, and also by mildews, and by *Alternaria* leaf-spot. Under Cereals he discusses the prevalence of rusts. Potatoes are subject to *Phytophthora infestans*; and powdery scab (*Spongospora subterranea*) is so prevalent and widespread that it is considered to be indigenous. Wart disease has also been reported as well as other fungi, such as rusts, mildew, and ground rots, due to *Fusarium*. Stem-rot (*Corticium vagans*) attacks many economic plants. Many diseases are here reported that had not previously been known in Peru.

A. L. S.

Disease of Lavender.—C. R. METCALFE ("The 'Shab' Disease of Lavender," *Trans. Brit. Mycol. Soc.*, 1931, 16, 149–76, 1 pl., 6 text-figs.). The cultivation of Lavender has been seriously injured in this country by a disease called "Shab." An examination of the disease and also of the conditions of cultivation have been undertaken, and the results are given. The fungus was found to be *Phoma Lavendulae*; the early symptoms and the development are described, the origin of infection discussed, and the means of prevention. It was also proved that similar symptoms were induced by adverse climatic and environmental factors, etc. The earliest appearance is a yellowing and wilting of the young shoots from May onwards; infection takes place through or near leaf-axils, or through freshly made wounds, and is spread by raising plants from cuttings in which the disease is established, or by contact of the healthy plants by disease bearing leaves, twigs, etc. Means for control have been sought in plant sanitation, the clearing out of weeds—especially *Chenopodium album*, also a host of the parasite—and other careful management. These methods have met with considerable success.

A. L. S.

Disease of Strawberry Plants.—FORREST C. STRONG and MIRIAM C. STRONG ("Investigations on the Black Root of Strawberries," *Phytopathology*, 1931, 21, 1041–60, 6 text-figs.). Strawberry plants have generally been considered as particularly free from disease, but in recent years there have been repeated records of plants dying at the roots. The disease has been reported from widespread localities, and in Michigan it has been particularly severe. The attack with the appearance of the disease is described, as it affects the growing plants. The fungoid and infectious nature of the disease has been amply proved by the writers; microscopic examination of diseased roots showed the constant presence of hyphae in the diseased areas. Two fungi have been isolated and determined: the *Comiothyrium* stage of a *Leptosphaeria* and the *Hainesia* stage of a *Peizella*. Each of these organisms by infection developed the disease; both are widely distributed on many

different hosts. It is suggested that other pathogens may be also present, as several different fungi such as *Fusaria* were identified. Methods of control are suggested, such as rotation of crops and the selection of resistant strains. The literature dealing with strawberry disease is listed.

A. L. S.

Pathogenic Fungus.—A. and R. SARTORY, J. MEYER, and CHARLES ("Un nouveau *Mycoderma* pathogène: *Mycoderma nobile* n.sp.," *Ann. Mycol.*, 1931, 29, 325–38, 6 text-figs.). The fungus was found to cause lesions on the arm of the patient; it was isolated and cultured, and the development has been followed and described. It was finally diagnosed as a member of the Hyphomycetes. The treatment of the patient is also described.

A. L. S.

Lichens.

New Species from Saxony.—E. RIEHMER ("Eine neue Flechte aus Sachsen," *Hedwigia*, 1931, 71, 305–10, 5 text-figs.). Riehmer describes a new *Porina* species in the section, *Segestria*, with the thallus growing up and round the perithecium. He has described a somewhat peculiar condition with several distinct thalline layers; above an epinecral layer of dead gonidial cells, below that a gonidial layer, then a dark latticed medulla, and again a gonidial layer bordering on a hyponecral base. He has minutely described the tissues, the most peculiar of which is the medulla of dark empty cells, not continuous, but with intruding gonidial masses. He notes the slender hyphæ surrounding the gonidia, their form he considers being due to great moisture and shelter from too direct light.

A. L. S.

Usnea longissima in Sweden.—STEN AHLNER ("Usnea longissima Ach. i Skandinavien," *Svensk Bot. Tidskr.*, 1931, 25, 395–416, 3 text-figs., Swedish with German summary). *Usnea longissima* is a lichen of world-wide distribution, though not found in the British Isles. It is not uncommon in Scandinavia, where it grows almost exclusively on *Picea excelsa* in clumps or in garlands from branch to branch; the var. *contorta* Elenken, Ahlner considers to be only a growth form. It has been found in sixty-six different localities in Sweden, twenty-four in Norway, and the map accompanying the paper shows that the localities are mainly Eastern—probably it has come from the East, and may have travelled along with the pine. It is rare in Finland and North Russia, though of frequent occurrence in Siberia, and in certain districts of China.

A. L. S.

Lichens of Jugoslavia.—M. SERVIT ("Flechten aus Jugoslawien. Sud-Dalmatien und Lovčén," *Hedwigia*, 1931, 71, 215–82, 2 text-figs.). The author gives a sketch of forty-six localities, with the principal rocks and the lichen species found in each. He notes also the weather conditions—moisture and prevailing winds, as well as the altitude and exposure to light. Several new varieties of lichen are described. European genera are well represented; one notes the absence of any species of *Usnea*, though four species of *Ramalina* are recorded.

A. L. S.

Lichens from Northern India.—A. LORRAIN SMITH (*Trans. Brit. Mycol. Soc.*, 1931, 16, 128–32). The lichens were sent by Prof. Chaudhuri for determination. They were collected mainly by his pupil, G. L. Chopra, at or near Darjeeling, Sikkim, Kashmir, etc. Locality and habitat were fully supplied. One new species and several new varieties are described, one a species of *Anzia*, in which the rhizinae were coated by the netted tomentum which usually forms a mat-like covering of the lower side of the thallus.

A. L. S.

Lichens of Esthonia.—VELI RÄSÄNEN ("Die Flechten Estlands, I," 1931, 1-163, Helsinki). Räsänen recalls the publication by Brütten in 1870 of a lichen flora of Livland (Livonia), Kurland (Curonia), and Estland (Esthonia). The species then known numbered 394; those of Estland alone 300. Other lichenologists have collected over the same ground, and Räsänen has made use of their work; he has followed Wainio's system of classification. Descriptions of species already known are not given, but localities and biological notes with localities are published. In the preface he gives an account of conditions that have interfered with the growth of lichens—such as the cutting down of woods, the development of cultivation, and the advance of industrial conditions. Certain genera are, however, well represented, as, for instance, *Ramalina* and *Usnea*, with several new species and varieties. With every genus he gives keys to the species. This first part deals with thirty-seven genera. A. L. S.

Lichens from Kerguelen.—BOULY DE LESDAIN ("Lichenes recueillis en 1930 dans les îles Kerguelen, Saint Paul et Amsterdam par M. Aubert de la Rue," *Ann. Crypt. Exot.*, 1931, 4, 98-103). Most of the lichens enumerated are saxicolous species. One notes with satisfaction that references are given to numbers in Zahlbruckner's Catalogue. A number of species new to science are carefully described, and generally with a descriptive note. A. L. S.

Notes on Lichens.—V. J. GRUMANN ("Lichenologische Berichte I," *Repertorium*, 1931, 29, 310-20). Grumann records various diversities in lichen development that he has observed: *Lecanora varia* f. *innovata* had developed new apothecia on the old owing to the disturbance caused by a parasitic fungus. Other instances of proliferation are recorded on *Lecanora cenisia*, *L. pallida*, *Ochrolechia tartarea*, *Xanthoria parietina*, etc. In a discussion on *Rhizocarpon* he cites instances where corticolous forms of rock species have been found and described. A. L. S.

Lichens of Dummersdorfer.—C. F. E. ERICHSEN ("Die Flechten am Dummersdorfer Traveufer bei Lübeck," *Das Linke Untertraveufer Dummersdorfer Ufer*, Lübeck, 1932, 126-53, 2 pls., 1 text-fig.). The author gives an account of the territory explored by him on the banks of the Trave, where other botanists were examining the general flora. Lichens were not abundant partly on account of the near proximity of a blast furnace, and much of the soil unstable. Many species, however, were found on trees in the vicinity, and on a mossy substratum. Others were found on blocks of stone though not in great abundance, and on trees in the neighbourhood. Lists are given according to these different habitats or associations, and a complete enumeration of the whole 121 species. Included in the list are one new species, *Arthopyrenia lubecensis*, a saxicolous lichen, *Verrucaria acrotella*, var. *leptospora* var. *nov.*, and *Buellia myriocarpa* var. *stigmatea* with a new f. *crassior* distinguished by a thick thallus. A. L. S.

New Lichens.—M. CHOISY ("Lichens nouveaux," *Bull. Soc. Bot. France*, 1931, 78, 453-60). The author gives a considerable list collected mostly in N. Africa or in India. The paper is distinguished not only by new species but by new genera or new names for old genera. Thus *Antilyssa* (Haller, 1768) is substituted for *Peltigera*; *Byssophragma* nov. gen. with a *Crocynia*-like thallus, but with a *Lecanactis*-like apothecium and three septate spores. *Chrysomma* Acloque (1893) similar to *Caloplaca*, but with proper margin only (? *Blastenia*), the new species differs slightly from *Caloplaca velana*; *Dievernia* (*Euramalina*); (section of *Ramalina*); *Dirinella* near to *Dirina* but with simple spores; *Malmia* near to *Rinodina* but with biatorine apothecia; *Mischolechia*, also near to *Rinodina*. Choisy also

revives *Parmotrema*, a synonym of *Parmelia* section *Amphygymnia*, and similarly he elevates *Physcia* section *Sordulenta* Wain. to generic status with a new species, *Sordulenta isidiata*.
A. L. S.

Italian Lichens.—CAMILLO SHARBARO ("Contributo alla Flora Lichenologica Ligure," *Arch. Bot.*, 1931, 7, 276-95). The author notes that no lichen flora of Liguria has been issued since the publication of Baglietto's work in 1857. He indicates by a single asterisk the species not included in Baglietto, and by two asterisks those new to Liguria and to Italy. In this first contribution he has enumerated 130 species belonging to Pyrenolichens, Graphidaceæ, and those with blue-green gonidia.
A. L. S.

Study of Parmeliæ.—V. GYELNIK ("Additamenta ad Cognitionem Parmeliarum," I. *Fedde Repert.*, 1931, 29, 149-57; II. *Tom. cit.*, 273-91). In these papers Gyelnik gives a result of his studies of various *Parmeliæ*. He lays great emphasis on the colour reactions, and also on the presence of isidia. Especially in the second paper he emphasizes the importance of these isidia, their occurrence and their form, with which is included their geographical distribution. He treats all these differences as indicating either separate species or varieties, and thus necessitating careful description. He has also given a survey of European *Xanthoparmeliæ*. He describes many new species and new combinations—previous varieties considered by him as species.
A. L. S.

Mycetozoa.

Japanese Mycetozoa.—G. LISTER ("New Species of Mycetozoa from Japan," *Journ. Bot.*, 1931, 69, 297-98, 1 pl.). A package of Mycetozoa specimens collected by the Emperor of Japan have been recently sent to the author; two of the species determined were found to be new to science: *Didymium ochroideum* and *Perichaena tessellata*; diagnoses of these are given.
A. L. S.

TECHNICAL MICROSCOPY.

The Lateral Chromatic Aberration of Apochromatic Microscope Systems.—By I. C. GARDNER and F. A. CASE (*Bur. Standards Journ. Res.*, 1931, 6, 937-46, 3 figs., Res. Paper 316). In this paper methods are described by which the lateral chromatic aberration of microscope objectives and eyepieces may be measured. To test this aberration a scale is placed upon a microscope stage and photographed in three different colours by means of the objective. The photographic plate is adjusted in the image plane corresponding to the stated tube-length of the particular objective. By means of a comparator the distance between any two lines on the plate may be obtained, and hence the magnifications of the objective for one colour relative to that for another.

The method for testing eyepieces is only suitable in the case of positive eyepieces. A scale ruled with lines 4 mm. apart forms the object to be photographed by the eyepiece which is mounted with its eye-lens towards the object. A photographic plate is placed in the plane conjugate to that of the object, and three photographs taken as above. From these the distortion and relative magnifications for different parts of the field may be determined. Tabulated results are given for ten compensating eyepieces.

Similar results are given for twelve selected combinations of objectives and eyepieces. The authors come to the conclusion that compensating eyepieces, in general, do not entirely compensate the chromatic aberration of the objectives, and that there is usually undercorrection.

It would appear that the paper deals with differences in chromatic magnification and chromatic distortion rather than with what the title indicates. J. S.

Interpretation of Photomicrographs.—D. JORDAN LLOYD and R. H. MARRIOTT (*Journ. Int. Soc. Leather Trades Chem.*, 1932, 16, 57–93). A series of fifty-two photomicrographs showing fibre structure in both satisfactory and unsatisfactory pelt and leathers, illustrating how qualities of leather depend upon the weave of the fibre bundles. Weave patterns are divided into five classes: vertical, high angle, medium angle (about 45°), low angle, and horizontal, the pattern being judged by the outstanding direction of the fibres. Regularity or otherwise of the weave should be noted, bad tanning disturbing the orderliness, while observations are also made on the compactness and splitting of the fibres. Each photomicrograph is fully explained. A. H.

Uses of the Microscope in Leather Manufacture.—E. C. LINE (*Journ. Int. Soc. Leather Trades Chem.*, 1932, 16, 93–102). The author emphasizes the utility of the microscopical examination of leather as a means of identifying methods of manufacture, especially with patent and “dope” finished leathers. Coupled with solubility tests, the nature of individual coatings may be ascertained. Stains, fatty and salt “spues” or exudations can be similarly examined. The text is suitably illustrated by nine photomicrographs. A. H.

Identification of Wood and Wood Charcoal Products.—J. C. MABY (*Analyst*, 1932, 57, 2). Identification of wood from which a charcoal has been derived can often be made by observation of a hand-broken section through a good hand lens or low-power microscope, as even after thousands of years characteristic wood structure is retained. Wet samples are dried preferably in desiccators over some hygroscopic substance. Tough woods are given a prolonged soaking in a mixture of 1:1 water and hydrofluoric acid to remove silicious matter, followed by thorough washing in water, dehydration in alcohol, and storage in alcohol-glycerol mixture.

Fine textured charcoals are embedded in celloidin, and the section mounted in Gurr's medium, which appears slowly to dissolve the nitrocellulose and so clear the section. Embedding in a synthetic resin has also proved satisfactory, but is laborious. Features looked for are: (a) size and configuration of conducting vessels as seen in transverse section; (b) size, etc., of medullary rays as seen in transverse and tangential longitudinal sections; (c) distribution, etc., of wood fibres as seen in transverse section; (d) amount and arrangement of storage parenchyma as seen in transverse and radial longitudinal sections; (e) presence or absence of resin ducts as seen in transverse and tangential longitudinal sections. The paper is illustrated by twelve photomicrographs. A. H.

NOTICES OF NEW BOOKS.

Practical Microscopy.—By L. C. MARTIN, F.R.A.S., D.Sc., A.R.C.S., D.I.C., and B. K. JOHNSON, F.R.M.S. 1931. 116 pp., 10 plates, 78 text-figs. Published by Blackie & Son, Ltd., 50, Old Bailey, London, E.C.4. Price 3s. 6d. net.

Index Animalium.—By C. D. SHERBORN. 1931. Part XXV, pp. 6119-358. Part XXVI, pp. 6359-582. Published by the Trustees of the British Museum (Natural History), Cromwell Road, London, S.W.7. Price 10s. each part.

Beiträge zur kriminalistischen Symptomatologie und Technik.—Edited by Prof. Dr. SIEGFRIED TÜRKEL. 1931. iv + 173 pp., 68 plates. Published by Ulr. Moser's Verlag, Schönaugasse 64, Graz, Austria. Price RM. 17.80.

Atlas der Bleistiftschrift.—By Prof. Dr. SIEGFRIED TÜRKEL. 48 pp., 76 plates. Published by Ulr. Moser's Verlag, Schönaugasse 64, Graz, Austria. Price RM. 17.

The Microscopic Characters of Artificial Inorganic Solid Substances or Artificial Minerals.—By A. N. WINCHELL. With a chapter on the Universal Stage, by R. C. EMMONS. 2nd edition, 1931. xvii + 403 pp., 311 text-figs. Published by John Wiley & Sons, Inc., New York, and Chapman & Hall, Ltd., 11, Henrietta Street, Covent Garden, London, W.C.2. Price 31s. net.

Das Mikroskop und seine Anwendung.—By Dr. HERMANN HAGER. 14th edition, 1932. Edited by Dr. FRIEDRICH TOBLER. 368 pp., 478 text-figs. Published by Julius Springer, Linkstrasse 23-24, Berlin W9, Germany. Price RM. 16.50.

Watson's Microscope Record.—No. 25. January, 1932. 24 pp., illustrated. Published gratis by W. Watson & Sons, Ltd., 313, High Holborn, London, W.C.1.

Elementary Textile Microscopy.—By JOHN H. SKINKLE, S.B. With a Foreword by LOUIS A. OLNEY, D.Sc. 1930. 144 pp., 95 text-figs. Published by the Howes Publishing Company, 440, Fourth Avenue, New York, N.Y., U.S.A. Price \$3.00.

The Technical Instrument Bulletin.—Edited by A. G. FREWIN. Vol. 3, No. 6, January, 1932. 16 pp., 9 figs. Published gratis by the Emil Busch Optical Co., Ltd., Diamond House, Hatton Garden, London, E.C.1.

Permanent Microscopical Preparations of Animal Material.—By E. M. STEPHENSON, M.Sc. 1932. 12 pp., 3 text-figs. Published by Cornish Brothers, Ltd., 39, New Street, Birmingham. Price 9d.

Sulphur Bacteria. A Monograph.—By DAVID ELLIS, D.Sc. 1932. ix + 261 pp., 66 figs. Published by Longmans, Green & Co., Ltd., 39, Paternoster Row, London, E.C.4. Price 21s. net.

A Handbook of the British Seaweeds.—By Prof. LILY NEWTON, Ph.D., F.L.S. 1931. xiii + 478 pp., 270 text-figs. Published by the Trustees of the British Museum (Natural History), Cromwell Road, London, S.W.7. Price 15s.

Prof. Lily Newton has performed a very useful work in producing this modern handbook, which has long been needed. In connection with its preparation she had access to the extensive collection of specimens and slides in the Botanical Department of the Museum. Some 260 genera and 750 species of algæ are described, and the main features are illustrated by clear line drawings nearly all of which are new. A short introduction is followed by keys to the genera, together with classifications of the various groups, and short but adequate descriptions of the species with indications of the distribution and of their rarity or abundance in Britain. The work concludes with a list of principal authors, glossary, and index. It is a book which every naturalist interested in algæ will wish to possess. The classification of the Chlorophyceæ, which is always a difficulty, is more conservative than that of West and Fritsch, a feature which will appeal to many in a work of this kind.

R. R. G.

The Essentials of Bacteriological Technique.—By R. F. HUNWICKE, B.Sc., A.I.C., F.R.M.S. With an Introduction by WILLIAM G. SAVAGE, M.D., B.Sc., D.P.H. 1931. 108 pp., 22 text-figs. Published by Williams & Norgate, Ltd., London. Price 6s. 6d. net.

In the earlier portion of the book some very useful "tips" are given, such as the importance of having each piece of electrical equipment on a separate circuit with its own fuse, and the sterile-water apparatus figured on p. 31. The bacteriological examinations of water, tinned foods, and milk are well described, but there is no reference to the Ministry of Health standards for certified milk, etc. Examinations for the diagnosis of cholera, diphtheria, gonorrhœa, pneumonia, tuberculosis, and typhoid fever are detailed in two-and-a-half pages, and are too brief to be of much value.

The description of the Rideal-Walker method for the determination of disinfectants is very sketchy, and no one could carry it out from the details given. Nothing is said about the standard phenol or the standard loop, and no one uses "drops" of culture nowadays. The Martin-Chick method is not referred to. The book, therefore, while useful in some respects, is sadly wanting in others.

R. T. H.

Experiments in Electro Farming.—By S. S. NEHRU. 1931. Bull. No. 53. 151 pp., 45 figs. Govt. Press, Allahabad, India.

This Indian Agricultural Bulletin gives the results of two years' experimentation on the effects of electric currents on crop plants, horticultural plants, and fruit trees. The work has strictly practical aims, and records a number of apparently successful results in which increased growth and yield followed electrical treatment. Seeds in a dish were subjected to a high tension spark of 1,000–18,000 volts, derived from the lighting equipment of a motor car by the use of an induction coil. A resulting increase in yield in wheat and many other plants, ranging from 50 p.c. to 150 p.c., is claimed, but no evidence is given for the statement that these effects endure in later generations. A better method, applied to mangoes, potatoes, broom-corn, and other plants, was to energize the soil by inserting an instrument which produced electric sparks under the roots of the plants. It is claimed that this method also enables plants to resist diseases, such as wheat rust and smut, more successfully. Treatment of sugar-cane plants is said to result in increased growth and a higher

sucrose content. Horticultural plants were treated to feeble currents (0.1 volt, 0.1 ampere) for a few minutes each day, with results believed to be as beneficial as the intense soil treatment. Dr. Nehru discusses the theory of electro-culture, referring to the work of V. H. Blackman and others. While his experiments require confirmation, they create a presumption that a variety of electrical treatments will produce marked stimulative effects. If some of these effects are directly on the nuclei, it is probable that inherited changes or mutations would be produced, as with X-rays and radium.

R. R. G.

Elementary Histological Technique for Animal and Plant Tissues.—

By J. T. HOLDER, F.R.M.S. viii + 100 pp., 23 figs. Published by J. & A. Churchill, 40, Gloucester Place, Portman Square, London, W.1. Price 7s. 6d.

A feature specially characteristic of British Science in the past has been the number and value of the contributions which have been made by those who without disparagement may be called amateurs, men who while actively engaged in the world of affairs have yet found time to study the sciences that they loved. Recently the number of such independent workers has unfortunately decreased, for while the opportunities for filling one's leisure have increased in number and diversity science, in all its branches, has become ever more specialized. Without intensive training and study, it is therefore increasingly difficult to achieve something more than mere dilettanteism. To those who, despite difficulties and counter attractions, have resolved to master any of the microscopical aspects of biology for which some knowledge of histological technique is essential, this book may be unreservedly recommended. While it does not aim at completeness it provides a sound basis of fact on which further additions to knowledge can be built. The methods necessary for fixation and hardening, dehydration, clearing, and embedding of animal and plant tissues are well described, and the use of a few well-known stains is discussed in detail. Both the plant and animal sections conclude with a useful set of exercises. When the beginner has mastered these he will be in a position to grapple with more advanced treatises on histological technique.

G. M. F.

The Glycosides.—By E. F. ARMSTRONG, D.Sc., Ph.D., LL.D., F.R.S., and K. F. ARMSTRONG, B.A., B.Sc. vii + 123 pp. Published by Longmans, Green & Co., Ltd., 39, Paternoster Row, London, E.C.4. Price 12s. 6d.

This addition to the well-known monographs on Biochemistry is in every way worthy of its predecessors in this important series, and amply supplements the account of the glycosides which formed a section only in the writers' former work on the simple carbohydrates. An adequate balance has been preserved between the three most important aspects of the subject; the nature and meaning of the sugars, the constitution of the aglucones, and the biological significance of the glycosides. A very complete bibliography is included.

G. M. F.

PROCEEDINGS OF THE SOCIETY.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD IN THE HASTINGS HALL, BRITISH MEDICAL ASSOCIATION HOUSE, TAVISTOCK SQUARE, LONDON, W.C.I, ON WEDNESDAY, DECEMBER 16TH, 1931, AT 5.30 P.M., PROF. R. RUGGLES GATES, M.A., PH.D., LL.D., F.R.S., PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the President.

New Fellows.—The following candidates were balloted for and duly elected Ordinary Fellows of the Society :—

Francis Johns Corin, L.D.S., St. Ives.
Edward Hindle, M.A., Sc.D., Ph.D., London.

Nomination Certificates in favour of the following candidates were read for the first time, and directed to be suspended in the Rooms of the Society in the usual manner :—

R. G. Austin, B.Sc., A.I.C., London.
Arthur Carpenter, New York.

Donations were reported from :—

Messrs. Longmans, Green & Co., Ltd.—

“The Glycosides.” By E. F. Armstrong and K. F. Armstrong.

Dr. E. W. Howell—

39 vols. “Journal of Pathology and Bacteriology,” 1892–1931.

Dr. G. De Toni—

“Bibliographia Algologica Universalis.” Part I—Ab–Az. By J. De Toni.

Votes of thanks were accorded to the donors.

The Death was reported of :—

Lady Bruce. Hon. Fellow. Elected 1918.

A vote of condolence with the relatives was passed.

Signing the Roll.—The following gentlemen being present, subscribed their Signatures to the Roll, and were duly admitted Fellows of the Society :—

Mr. Charles H. Bartlett.
Prof. Edward Hindle.

New Council.—The Secretary read the By-Laws relating to the election of Council.

Nominations to serve on the Council for the ensuing year were read and approved.

Papers.—The following communications were read and discussed :—

Prof. Edward Hindle, M.A., Sc.D., Ph.D.

“Thermophilic Micro-Organisms.”

Mr. A. P. H. Trivelli and Mr. E. Lincke.

“Photomicrography of *Amphipleura pellucida*,” communicated by Mr. J. E. Barnard, who subsequently exhibited some lantern slides of *Amphipleura pellucida* he had recently photographed in ultra-violet light. Mr. B. K. Johnson also exhibited a lantern slide of a similar photograph he had taken.

Hearty votes of thanks were accorded to the authors of the foregoing communications, and to Mr. Barnard and Mr. Johnson for their exhibits and supplementary observations.

Announcements.—The President made the following announcements :—

The Rooms of the Society will be closed from December 23rd to 29th, 1931.

The Biological Section will meet in the Pillar Room at 6 p.m. on Wednesday, January 6th, 1932.

The Annual General Meeting of the Society will be held on Wednesday, January 20th, 1932, when Prof. R. Ruggles Gates, M.A., Ph.D., LL.D., F.R.S., will deliver the Presidential Address.

The proceedings then terminated.

THE ANNUAL GENERAL MEETING

OF THE SOCIETY WAS HELD IN THE HASTINGS HALL, BRITISH MEDICAL ASSOCIATION HOUSE, TAVISTOCK SQUARE, LONDON, W.C.1, ON WEDNESDAY, JANUARY 20TH, 1932, AT 5.30 P.M., PROF. R. RUGGLES GATES, M.A., Ph.D., LL.D., F.R.S., PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the President.

New Fellows.—The following candidates were balloted for and duly elected Ordinary Fellows of the Society :—

R. G. Austin, B.Sc., A.I.C., London.
Arthur Carpenter, New York.

Nomination Certificates in favour of the following candidates were read for the first time, and directed to be suspended in the Rooms of the Society in the usual manner :—

Thomas S. Beardsmore, Hinckley.
Francis Davies, M.D., London.
John David Roberts, B.Sc., West Acton.

Donations were reported from :—

Prof. R. Ruggles Gates, F.R.S., P.R.M.S.—

A Collection of Papers on Foraminifera. By J. A. Cushman and Others.

Mr. R. F. Hunwicke, B.Sc., A.I.C., F.R.M.S.—

"The Essentials of Bacteriological Technique." By R. F. Hunwicke.

Prof. Dr. Siegfried Türkel.—

"Beiträge zur kriminalistischen Symptomatologie und Technik."
Edited by Dr. S. Türkel.

"Atlas der Bleistiftschrift." By Dr. S. Türkel.

Trustees of the British Museum—

"Index Animalium." Parts XXV and XXVI. By C. D. Sherborn.

"A Handbook of the British Seaweeds." By Dr. Lily Newton.

Messrs. Blackie & Son, Ltd.—

"Practical Microscopy." By L. C. Martin and B. K. Johnson.

Messrs. Chapman & Hall, Ltd.—

"The Microscopic Characters of Artificial Inorganic Solid Substances or Artificial Minerals." By A. N. Winchell. 2nd edn.

Votes of thanks were accorded to the donors.

The Annual Report of the Council for the year 1931 was read by the Secretary as follows :—

ANNUAL REPORT OF THE COUNCIL FOR THE YEAR 1931.

FELLOWS.

Since the last Report the Council has had to deplore the loss by death of one Honorary Fellow and twelve Ordinary Fellows, while fourteen have resigned, and six have been removed from the Roll under By-Law 31.

The deaths reported are as follows :—

Dame Mary Elizabeth Bruce. Elected 1918. Hon. Fellow.
 Dame Catherine Crisp. Elected 1884.
 Daniel Davies. Elected 1908.
 Maturin L. Delafield. Elected 1924.
 J. S. Dunkerly. Elected 1921.
 O. T. Elliott. Elected 1899.
 J. B. Fleuret. Elected 1919.
 Samuel Glover. Elected 1912.
 F. W. Harris. Elected 1928.
 John A. Miller. Elected 1891.
 Lt.-Col. A. C. Robinson. Elected 1924.
 Herbert Sutcliffe. Elected 1918.
 R. R. Whitehead. Elected 1886.

Three Honorary Fellows and twenty-nine Ordinary Fellows have been elected, and five have been re-instated.

MEETINGS.

Eight Meetings of the Council and eight Ordinary Meetings of Fellows have been held during the year. The business and scientific proceedings conducted at the Ordinary Meetings have been duly published in the Society's Journal, and it is worthy of note that the attendances have been good. It is a matter of regret to the Council that it has not seen its way clear on account of the expense involved to arrange an annual conversazione for Fellows and their guests, but the desirability of this function has not been overlooked.

The Society conveys its thanks to the following firms, which have kindly lent instruments for use at the Meetings during the past year : Messrs. R. & J. Beck, Ltd., Messrs. E. Leitz (London), and Messrs. W. Watson & Sons, Ltd.

JOURNAL.

Four quarterly parts of the Society's Journal have been published during the year, comprising some five hundred and eleven pages of letterpress, and forty-six plates. Twenty original communications have been published in the Journal, in addition to the extensive series of abstracts of foreign publications on microscopy and its applications.

Included in the volume is a series of papers on "Experimental Studies in Diffraction," by the late Mr. F. W. Shurlock, which, in view of their importance and value for class and other instructional purposes, the Council decided to publish *in extenso*, and provision has been made for a limited supply of reprints of this series, which are available to Fellows and others at a small charge.

The high standard of the Society's Journal as the authoritative publication on technical and applied microscopy continues to command world-wide recognition and support, and, despite the universal economic depression, the circulation continues, though the stringent monetary conditions are reflected in the temporary suspension of a few of the foreign subscriptions.

The thanks of the Fellows are due, and are hereby conveyed, to the Editor, Dr. G. M. Findlay, and to the Panel of Abstractors, for their valued services during the year.

The Council reports that arrangements have been made with Messrs. Wheldon & Wesley, Ltd., for the disposal of the remaining stock of back numbers of Series II (1878-1926) of the Society's Journal.

LIBRARY.

The Library is in good order and condition, and has been entirely re-arranged and re-indexed.

The number of visitors thereto during the year is two hundred and fifty-one, and the number of volumes borrowed one hundred and forty, exclusive of those works of reference consulted in the Library. In addition, six volumes have been borrowed through the National Central Library to meet the requirements of Fellows, and sixteen volumes have been loaned to the National Central Library.

Since the last Report one hundred and sixty-eight volumes have been added to the Library, in addition to the normal accessions received in exchange for the Society's publications.

In consequence of the prevailing financial stringency it has not been found possible to publish the urgently needed supplement to the Library Catalogue, which it is hoped to undertake as soon as the Society's resources will allow. It should be added, however, that particulars of new accessions are regularly included in the reports of the Proceedings published in the Society's Journal.

Donations to the Library have been received, and gratefully acknowledged, from: Messrs. George Allen & Unwin, Ltd., Messrs. Baillière, Tindall & Cox, Dr. E. W. Bowell, Trustees of the British Museum, Messrs. Cassell & Co., Ltd., Messrs. Chapman & Hall, Ltd., Messrs. J. & A. Churchill, Dr. G. De Toni, Prof. R. Ruggles Gates, M. E. Goddefroy, Sir Robert Hadfield, Dr. J. A. Braxton Hicks, M. Paul Lechevallier, Messrs. Longmans, Green & Co., Ltd., Mr. F. J. Myers, Oxford University Press, Photomicrographic Society, Royal Dublin Society, Mr. Elliot Stock, Herren Urban & Schwarzenberg, and Mrs. Edmund Warner.

INSTRUMENTS AND APPARATUS.

(Curator's Report.)

The Curator is glad to report that eminently satisfactory provision has been made for the appropriate housing in the Society's meeting hall of a portion of the Society's unique collection of historical instruments.

Thanks to the negotiations initiated and carried through by the Secretary, and the generous assistance of the Society's Landlords, to whom the thanks of the Fellows are due, a handsome and well-lighted exhibition case has now been installed. The instruments placed on view therein, all of which have been properly labelled, make an imposing exhibition, and demonstrate in an appropriate manner the evolution of the microscope and its accessories, and the important stimulus and influence of the Society upon their development.

The thanks of the Fellows are due to Messrs. W. Watson & Sons, Ltd., for their kindness in cleaning and reconditioning these instruments for exhibition, without charge to the Society.

Thanks are also due to Messrs. R. & J. Beck, Ltd., for the loan of modern instruments for exhibition.

In addition to a new Epidiascope which has been purchased during the year for use at the Society's sectional meetings, the following donations have been added to the historical collection:—

Mr. G. F. Bates—

A William Cary Type of Microscope, c. 1828. Signed, Duncan, Aberdeen.

Mrs. Edmund Warner—

An Old Microscope of the Jones "most improved" Type, with Accessories in Case by Fairey, c. 1785.

A Ross Binocular Microscope with Accessories, in Case.

A Watson Binocular Microscope with Accessories, in Case.

A Ross Cover-Glass Gauge, in Case.

The Curator wishes to place on record his appreciation of, and thanks for, the help afforded him by the Treasurer and the Secretary in the arrangement of the instruments, and the Secretary's assistance in arranging for the labelling of the instruments.

SLIDE CABINET.

The following slides have been added to the Society's Collection during the year :—

Mr. F. J. Myers—

A Collection of Thirty-Four Specially Mounted Slides, including several Paratypes, of the Rotifer Fauna of Wisconsin.

Mr. J. Richardson—

A Slide of *Amphipleura pellucida* with *Epithemia*, Mounted in Hyrax.

These are valued accessions to the Society's Cabinet.

Thirteen slides have been borrowed from the Cabinet during the year.

GENERAL.

No application has been received during the year for the use of the Society's table at the Marine Biological Laboratory, Plymouth.

The Council has appointed a committee to consider and report upon the desirability of the standardization of biological stains.

The Council has also appointed a committee to consider the standardization of eye-piece and objective nomenclature, and of the types and gauges of sub-stage condenser mounts.

The Council appointed the President, Prof. R. Ruggles Gates, F.R.S., to represent the Society at the Centenary Meeting in London of the British Association for the Advancement of Science.

Mr. J. E. Barnard, F.R.S., was appointed as the Society's Delegate to the Faraday Centenary Celebrations in London.

BIOLOGICAL SECTION.

The Secretary of the Biological Section reports that the Section has held its full number of meetings (seven) during the year, which were all well attended, the average attendance being twenty-four. The number and interest of the short communications were well maintained, but the number of general exhibits did not show any marked improvement on the previous year. It is much to be desired that more exhibits should be brought to the meetings, not only of objects in which members themselves are specially interested, but also those about which they would like information. No visits were paid by the Section during the year to the laboratories of other Societies and Institutions.

On the motion of Mr. J. Wilson, seconded by Mr. S. C. Akehurst, the following resolution was carried unanimously :—

“ That the Annual Report be received and adopted.”

It was further resolved, on the motion of Mr. A. W. Sheppard, seconded by Mr. B. K. Johnson :—

“ That a very hearty vote of thanks be tendered to the Officers and Members of the Council for their services during the past year.”

Mr. J. E. Barnard responded.

New Council.—The President appointed Mr. J. Richardson and Mr. H. Taverner to act as scrutineers of the ballot for the election of Officers and Members of Council for the ensuing year, and subsequently declared the result of the ballot as follows :—

President.—Conrad Beck, C.B.E.

Vice-Presidents.—A. Earland ; R. Ruggles Gates, M.A., Ph.D., LL.D., F.R.S. ; J. Rheinberg, F.Inst.P. ; G. S. Sansom, D.Sc.

Hon. Treasurer.—C. F. Hill, M.Inst.M.M., A.Inst.P.

Hon. Secretaries.—J. E. Barnard, F.R.S., F.Inst.P. ; R. T. Hewlett, M.D., F.R.C.P., D.P.H.

Ordinary Members of Council.—W. A. F. Balfour-Browne, M.A., F.R.S.E., F.Z.S., F.E.S. ; D. M. Blair, M.B., Ch.B. ; E. W. Bowell, M.A., L.R.C.P., M.R.C.S. ; S. H. Browning, L.R.C.P., M.R.C.S. ; G. R. Bullock-Webster, M.A., F.L.S. ; G. M. Findlay, O.B.E., M.D., D.Sc. ; B. K. Johnson ; A. More, A.R.C.S., A.R.T.C., F.I.C. ; D. J. Scourfield, I.S.O., F.L.S., F.Z.S. ; J. Smiles, A.R.C.S. ; E. J. Sheppard ; H. Wrighton, B.Met.

Hon. Librarian.—Clarence Tierney, D.Sc., F.L.S.

Hon. Curator of Instruments.—W. E. Watson Baker, A.Inst.P.

Hon. Curator of Slides.—E. J. Sheppard.

Presidential Address.—In the absence of the President elect, Prof. R. Ruggles Gates called upon Dr. J. A. Murray to take the Chair while he delivered his Presidential Address on :—

“ Nuclear Structure ”

at the conclusion of which, Dr. Murray expressed his warm appreciation of the President's Address, and on the motion of Prof. D. M. Blair, seconded by Dr. G. M. Findlay, the following resolution was carried with acclamation :—

“ That the best thanks of this meeting be accorded to Prof. R. Ruggles Gates for his Presidential Address, and that he be asked to allow it to be printed in the Journal of the Society.”

Prof. Gates responded.

On the motion of the Chairman, a hearty vote of thanks was accorded to the Scrutineers.

Announcement.—The Chairman announced that the Biological Section would meet in the Pillar Room on Wednesday, February 3rd, 1932, at 6 p.m.

The proceedings then terminated.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD IN THE HASTINGS HALL, BRITISH MEDICAL ASSOCIATION HOUSE, TAVISTOCK SQUARE, LONDON, W.C.1, ON WEDNESDAY, FEBRUARY 17TH, 1932, AT 5.30 P.M., PROF. R. RUGGLES GATES, M.A., PH.D., LL.D., F.R.S., VICE-PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the Chairman.

New Fellows.—The following candidates were balloted for and duly elected Ordinary Fellows of the Society :—

Thomas S. Beardsmore, Hinckley.

Francis Davies, M.D., London.

John David Roberts, B.Sc., West Acton.

Nomination Certificate in favour of the following candidate was read for the first time, and ordered to be suspended in the Rooms of the Society in the usual manner :—

Harold Keith Box, Ph.D., Toronto.

Donations were reported from :—

Mr. Julius Springer—

“Das Mikroskop und seine Anwendung.” 14th edn. Hager—Tobler.

Messrs. Howes Publishing Company—

“Elementary Textile Microscopy.” Skinkle.

Messrs. Cornish Brothers, Ltd.—

“Permanent Microscopical Preparations of Animal Material.” Stephenson.

Messrs. Bausch & Lomb Optical Co., Ltd.—

“Catalogue of Microscopes and other Scientific Instruments.”

Votes of thanks were accorded to the donors.

Papers.—The following communications were read and discussed :—

Mr. S. C. Akehurst, F.R.M.S.

“ On the Structure of *Eudorina elegans* forma *ellipsoida*. ”

Mr. J. E. Barnard, F.R.S., F.R.M.S., and Mr. F. V. Welch, F.R.M.S.

“ The Resolution of *Amphipectura pellucida*. ”

Votes of thanks were accorded to the authors of the foregoing communications.

Announcement.—The Chairman announced that the Biological Section would meet on Wednesday, March 2nd, 1932, at 6 p.m.

The proceedings then terminated.

JOURNAL
OF THE
ROYAL MICROSCOPICAL SOCIETY.

JUNE, 1932.

TRANSACTIONS OF THE SOCIETY.

V.—THE RATE OF PENETRATION OF FIXATIVES.

535.826.7.

By BETTY M. L. UNDERHILL, B.A., B.Sc.(Oxon).

(Read May 18th, 1932.)

ONE PLATE AND ONE TEXT-FIGURE.

Introduction.

IN the standard handbooks of cytological theory and practice, the statements made concerning the actual rates of penetration of fixatives are extremely vague. This work was undertaken to begin to place a study of these rates upon a quantitative basis, and to provide definite figures in place of indefinite statements. The substances used were the eight compounds most commonly used in fixing fluids, namely, acetic acid, mercuric chloride, ethyl alcohol, osmium tetroxide, picric acid, formaldehyde, and potassium bichromate. They have so far been used singly and not in mixtures.

Up to the present, only one tissue has been tested, and it is not held that the figures here given are applicable to any other organ. It is hoped that the work will be extended by using other tissues and trying the common mixtures of fixatives instead of the separate compounds which compose them.

The organ chosen as most suitable for this initial investigation was the liver of the guinea-pig (*Cavia*). Its suitability is obvious from the fact that it is homogeneous in structure (except for blood vessels and bile ducts), hence penetration is even throughout its substance and the fixative has not to pass from one kind of cell to another. Other organs, such as kidney and brain, were considered, but there were objections to both of these. In both, several different types of cell are present; and the tubules of kidney introduce an additional complication, since it seems probable that

the fixative would diffuse more rapidly along their length than through their walls. The use of brain would involve a complicated technique, since it is not firm enough to hold its shape when pieces of a standard size are bored from it, as they were from liver in this investigation.

Work of a somewhat similar nature was undertaken by Krause (1926) and incorporated in his "Enzyklopädie des Mikroskopischen Technik." His results seem, however, to have been based upon one experiment only with each reagent. He gives no account of his methods, nor does he include the figures upon which he based his diagrammatic representation of the penetration rates. His findings are therefore, in many ways, unsatisfactory, and this work, though similar in scope, is designed to be more definite in its conclusions.

Method.

The fixatives were used at the mean concentrations in which they appear in the various common mixtures of which they are a constituent. These concentrations were—acetic acid, 5 p.c.; mercuric chloride, 5 p.c.; absolute alcohol; osmium tetroxide, 0.5 p.c.; picric acid, 0.7 p.c. (i.e. 70 p.c. of a saturated solution at 60° F.); chromic acid, 0.5 p.c.; formaldehyde, 4 p.c.; and potassium bichromate, 1.5 p.c.

The liver was removed from the guinea-pig a few moments after death, and cylinders were bored out of it with a metal cork borer of internal diameter 7 mm. These cylinders were fixed for 15 minutes in the case of mercuric chloride, alcohol, osmium tetroxide, picric acid, chromic acid, and formaldehyde. Acetic acid penetrated so rapidly and potassium bichromate so slowly that in order to obtain a measurable result, the times had to be varied. Suitable times were found to be 1 minute for acetic acid and 30 minutes for potassium bichromate. On being removed from the fixative, the pieces were immersed in 0.02 p.c. chromic acid. A small length was then cut from the middle of each cylinder, so removing the ends which had been fixed by longitudinal penetration. The slices were then left in 0.02 p.c. chromic acid for approximately a week, in order that the unfixed cells in the centre should become macerated, so leaving a sharp line of demarcation between the fixed outer rim and the rest of the tissue.

The blocks were sectioned transversely to the axis of the cylinder, and stained with iron hæmatoxylin and acid fuchsin.

The chromatin seemed to be much more resistant to maceration than the cytoplasm, for most of the nuclei took the hæmatoxylin to some degree, and it was the cytoplasmic counterstain which showed up the dividing line.

The distance of penetration was measured by means of a carefully graduated micrometer eyepiece. The mean of numerous cylinders was used in working out the penetration rate.

In some cases a little fixative has been carried over into the macerating solution in transferring the cylinders, and this has slightly affected the unfixed cells. There may have been also some diffusion of excess fixative

from the fixed into the unfixed cells during the early stages of maceration. The effect is, however, so slight that it in no way obscures the sharp line of demarcation. Thus in some (but not all) sections from osmium tetroxide material, a coarse reticulum is faintly seen in the unfixed cells, but the general state of their preservation is very bad and they cannot be confused with cells from the outer fixed rim.

Fixation and subsequent treatment cause shrinkage of the blocks, so to obtain the rate of entry into the fresh organ the amount of shrinkage was determined, and the rates multiplied by the shrinkage coefficient. The figures for the fixed tissue have to be multiplied, not divided, by this coefficient, since shrinkage will diminish the distance through which the fixative appears to have penetrated.

Results of the Investigation.

The figures obtained for the penetration rates are embodied in the following tables :—

TABLE I.

Distance of Penetration.												Mean.	Time.
													minutes.
Acetic Acid ..	40	35	35	55	52	40	37	—	—	—	—	42	1
Mercuric chloride ..	120	112	105	100	105	115	100	95	102	110	—	106	15
Absolute Alcohol ..	25	20	25	23	35	20	15	23	23	—	—	23	15
Osmium tetroxide ..	15	17	14	14	13	14	11	17	16	18	—	15	15
Picric Acid ..	12	13	12	12	15	16	17	10	15	17	17	14	15
Chromic Acid ..	10	12	10	12	13	14	11	20	15	—	—	13	15
Formaldehyde	4	5	5	5	6	4	5	—	—	—	—	5	15
Potassium bichromate	35	35	40	45	40	35	45	—	—	—	—	39	30

The close agreement of the figures obtained from different blocks should be noted.

TABLE II.

Fixative.	Shrinkage Coefficient.	Mean Penetration Rate into Fresh Tissue.	Mean Penetration Rate into Fixed Tissue.	Time.
		mm.	mm.	minutes.
Acetic Acid ..	1.5	0.79	0.53	1
Mercuric chloride ..	1.3	1.7	1.3	15
Absolute Alcohol ..	1.6	0.46	0.29	15
Osmium tetroxide ..	1.4	0.27	0.19	15
Picric Acid ..	1.4	0.24	0.17	15
Chromic Acid ..	1.4	0.22	0.16	15
Formaldehyde ..	1.5	0.09	0.06	15
Potassium bichromate ..	0.4	0.69	0.49	30

The fixatives will be considered separately in the order of their penetration rates.

The plate at the end of the paper illustrates the difference between the fixed and unfixed tissue.

The figures show the line of demarcation in a sector of the cylinder. The line is naturally more distinct in the actual section than in the photograph.

Acetic Acid (5 p.c.).—Acetic acid is essentially a nuclear fixative. Pure glacial acetic is said by Mann (1902) to act chiefly as a dehydrating agent. Protein particles tend to be kept separate by this acid which, in weak concentrations, causes acid albumins to be formed. Chondriosomes are dissolved away.

The name that this fixative has for rapid penetration is certainly justified. ("The strong acid is a highly penetrating reagent" Gatenby & Cowdry (1928), and "... Acide très pénétrant" Langeron (1913).) Owing to its surprisingly great speed of 0.53 mm. per minute (the figures given are for the fixed tissue), the time of fixation had to be reduced to 1 minute.

The fixed nuclei are well preserved and nucleoli can be clearly distinguished. The cytoplasm, on the other hand, is of uneven density and may contain vacuoles. No chondriosomes are, of course, present.

The centre of the section is so completely macerated as to be almost structureless. Nuclei are present in some cells as distorted masses of chromatin, and such cytoplasm as is left tends to be aggregated round the periphery of the cell.

Mercuric Chloride (pl. I, fig. 1) (5 p.c.).—The fixative action of mercuric chloride is due to its power of coagulating proteins, which are precipitated in a comparatively coarse network. A trabecular condition is reached by coalescence at the nodes of the net. Each trabecula is a perfectly transparent strand of jelly, and in the cell no well defined reticulum is apparent. Organs rich in chlorides are less efficiently fixed in mercuric chloride than are those poor in such substances, since the presence of the chloride ion diminishes the ionization of the sublimate.

The fixative penetrates quickly, the rate being 1.3 mm. in 15 minutes. The line of demarcation is very distinct, as the fixed cytoplasm takes up the acid fuchsin much more readily than does the unfixed.

In the fixed cells the cytoplasm is well preserved, though its density is somewhat uneven, and in some cells it presents a granular appearance. Nucleoli are distinctly visible in the nucleus, in which it is possible to detect the chromatin network.

The unfixed cells show large intracellular spaces, most of the cytoplasm having disappeared. The nucleus, where it is fixed at all, tends to be of a more uniform density than in the fixed cells. It may be distorted in shape.

Ethyl Alcohol (*Absolute*).—Absolute alcohol fixes by coagulating natural albumins and by dehydration. Mann (1902) states that alcohols of 90 p.c. or stronger greatly distort the nucleus, but this effect is not apparent in the sections under consideration.

0.29 mm. per 15 minutes was the figure obtained for the penetration

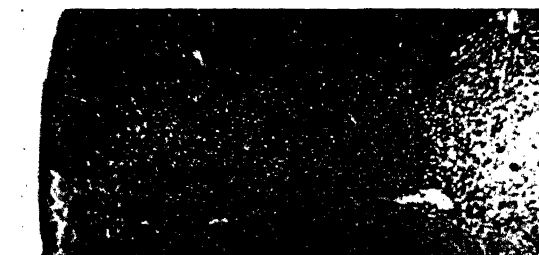


Fig. 1.
Mercuric chloride $\times 47$.



Fig. 2.
Osmium tetroxide $\times 80$.

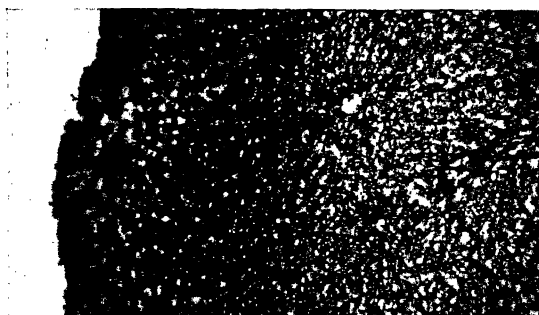


Fig. 3.
Potassium bichromate $\times 80$.

rate. This perhaps is less than would have been expected since the general impression seems to be that absolute alcohol penetrates very quickly (*vide* the statement in the "Microtometist's Vade Mecum"—"This (absolute alcohol) is sometimes valuable on account of its great penetrating power"). The dividing line between fixed and unfixed tissue is very distinct.

Both nuclei and cytoplasm are well preserved in the fixed cells, which show, however, a distinct shrinkage due to the dehydrating action of the alcohol (this substance has the highest shrinkage coefficient, 1.6). The density of the cytoplasm is somewhat uneven.

Large intercellular spaces are found in the central portion of the section to which the fixative has not penetrated.

Osmium Tetroxide (pl. I, fig. 2) (0.5 p.c.).—Osmium tetroxide forms more or less intimate additive compounds with protoplasm. In alkaline and neutral media "il fixe sans précipiter" Langeron (1913), and has the effect of making protein molecules cohere to one another.

The penetration rate of 0.19 mm. per 15 minutes differs but insignificantly from that of picric and chromic acids. This does not bear out the statements as to the extremely poor penetrating qualities of osmium tetroxide. "The penetrating power of the solution is very low." And—"son plus grand défaut est d'être très peu diffusible et par conséquent très peu pénétrant" Langeron (1913).

The cytoplasm of the fixed cells is of a fairly uniform density, though in some preparations a fine reticulum is present. Chondriosomes are very numerous in most of the cells. In some cases the brown deposit of a lower oxide of osmium is so dense as to obscure the structure. The line of demarcation is remarkably distinct.

A reticulum is clearly marked in many of the unfixed cells. This is due to the carrying over of a little fixative into the macerating fluid as already described. The intercellular spaces are very large and irregular.

Picric Acid (0.7 p.c.).—Picric acid is a stronger coagulant than acetic acid since it precipitates almost every cell constituent. Protein granules are at first separate, but they later coalesce and fuse, giving rise to large homogeneous masses in which vacuoles occur.

This fluid has a slightly lower rate of penetration (0.17 mm. per 15 minutes) than has osmium tetroxide, although it is commonly supposed to be one of the stronger penetrants. "L'acide picrique . . . est un des réactifs les plus pénétrants" Langeron (1913). Although it may be, and certainly is, a *strong* penetrant, that is to say it will ultimately find its way through the densest tissue, yet it is not one of the more rapid fixatives.

A fine reticulum is superimposed upon a fairly homogeneous protoplasmic background in some, but not all, of the fixed cells.

Where the unfixed cytoplasm has not been macerated away, a faint reticular structure can be seen in it. The nucleus is not so completely macerated as is the rest of the cell.

Chromic Acid (0.5 p.c.).—This acid has a strong oxidizing power and at

low concentrations has also a considerable solvent action upon tissues (Gatenby & Cowdry (1928)).

Though its rate of 0.16 mm. per 15 minutes is little less than that of picric acid, it is reported to have little penetrating power. "Chromic acid is not a very penetrating reagent" Gatenby & Cowdry (1928). "Il manque de pénétration et il produit dans le cytoplasme des réseaux artificiels" Langeron (1913).

In the fixed cells the cytoplasm has a very uniform density and a very fine reticulum can be distinguished. Chondriosomes are not visible.

Inter and intra-cellular spaces appear in the unfixed cells. The nuclei are distorted and no details of structure can be seen.

Formaldehyde (4 p.c.).—The action of formaldehyde consists in the formation of methylene compounds with the substances of the tissues. Protein molecules tend to cohere to one another.

This substance has almost the lowest rate of penetration, 0.06 mm. per 15 minutes, in spite of statements to the contrary. "It has a high degree of penetration. . . ." Gatenby & Cowdry (1928). "Il joue un rôle important à cause de son pouvoir coagulant et de sa remarquable puissance de pénétration" Langeron (1913). It is possible that "puissance" here refers, not so much to the speed with which the tissues are affected, but to the fact that they will ultimately be penetrated however hard they may be.

With this fluid the line of demarcation is not so distinct as in some of the other cases. Intercellular spaces sometimes occur even in the fixed rim.

In the centre of the sections it is difficult to distinguish any structure at all, as the maceration has destroyed many of the cell boundaries. As in other cases the nuclei appear to have been the most resistant to maceration.

Potassium Bichromate (pl. I, fig. 3) (1.5 p.c.).—Potassium bichromate is essentially a cytoplasmic fixative since it swells chromatin and obliterates structure in the nucleus. It has a hardening effect upon tissues and during its action becomes partially converted into the chromate.

It is a generally accepted fact that this substance is slow in action. "Potassium bichromate is a slow fixative. . . ." Mann (1902). And "The simple aqueous solution of bichromate is hardly to be recommended as a fixing agent, because not only does it not preserve nuclei properly, but also because it penetrates very slowly" Gatenby & Cowdry (1928). It is, indeed, the lowest of the eight, having a rate of 0.49 mm. in 30 minutes. In 15 minutes fixation seemed scarcely to have begun.

The nuclei in the outer rim of the section are homogeneous and structureless, due to the swelling effect above referred to. The cytoplasm is fairly dense.

Maceration has been very effectual in the centre of the section unreached by the fixative. Such protoplasm as is left is aggregated into scattered masses and cell boundaries have, for the most part, disappeared.

Further Experiment with Osmium Tetroxide.

It seemed desirable to ascertain whether the rate of penetration was even that is to say, whether doubling the time of fixation doubled the

distance of penetration. Osmium tetroxide was chosen as giving the most clearly defined line of demarcation, and cylinders of liver were fixed in this fluid (0.5 p.c.) for 15, 30, 45, and 60 minutes. They were subjected to the standard treatment, and on measurement gave the following results :

TABLE III.

Time	15 mins.	30 mins.	45 mins.	60 mins.
Micrometer divisions	15	22	29	40
Millimètres	0.19	0.27	0.36	0.5

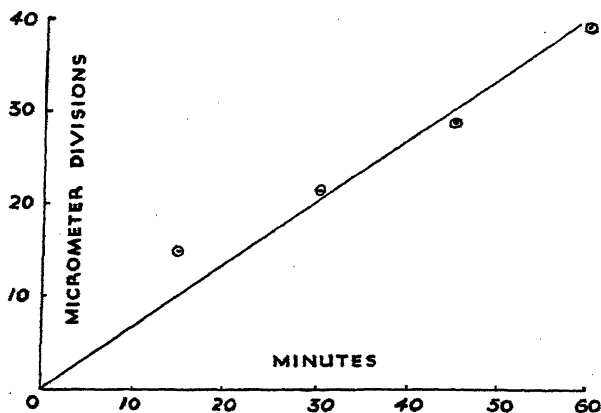


FIG. 1.

Discussion and Conclusion.

It is obviously not safe to draw conclusions from a single experiment, but the above results would indicate that, for osmium tetroxide, the penetration rate is fairly constant. In some cases, therefore, it might have been legitimate to give the figures as μ per minute, but this was not felt to be a wise proceeding in the absence of an adequate number of confirmatory experiments.

The fixatives fall into three groups, the very fast, the medium, and the very slow. To the first group belongs primarily acetic acid, and, to a much less degree, mercuric chloride. Of the middle group, consisting of alcohol, osmium tetroxide, picric acid, and chromic acid, alcohol is somewhat the fastest. Between the other three there is no significant difference. It would be possible to work out the probable error in this assumption, but it is manifestly unnecessary to do so. Formaldehyde and potassium bichromate bring up the rear with very low rates. Formaldehyde is a constituent of such rapidly penetrating fixatives as Bouin's fluid, so it must be presumed that it penetrates rapidly in the wake of other substances. It would seem that bichromate penetrated slowly during the first, rapidly during the second quarter of an hour, since in 15 minutes no fixed rim could be distinguished, but at the end of 30 minutes the fixative had penetrated for 0.49 mm.

Among the more surprising facts are those relating to the extreme slowness of formaldehyde and the comparatively great speed of mercuric chloride. Alcohol is considerably slower than might have been expected. The other figures do not differ greatly from expectation.

Although it is realized that this work is by no means exhaustive, it is hoped that it may serve as a basis for further investigation upon the subject.

Acknowledgments.

My thanks are due to Prof. E. S. Goodrich for allowing this work to be done in the Department of Zoology and Comparative Anatomy at Oxford. In addition, I should like to thank most particularly Dr. John R. Baker, whose advice and interest were invaluable.

DESCRIPTION OF PLATE.

The Plate shows microphotographs of a sector of the sectional cylinder showing the fixed (darker) outer rim and unfixed (paler) centre.

Fig. 1.—Mercuric chloride.

Fig. 2.—Osmium tetroxide.

Fig. 3.—Potassium bichromate.

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VI.—THE RESOLUTION OF AMPHIPLEURA PELLUCIDA. 582.615.

By J. E. BARNARD, F.R.S., and F. V. WELCH, F.R.M.S.

(Read February 17th, 1932.)

ONE PLATE.

THIS note is not intended as a contribution to the knowledge of diatom structure, but rather to indicate the increase of resolving power that has recently been achieved with this well-known object. All that has ever been done to determine the structure of *Amphipleura pellucida* is recorded in the Journal of this Society, probably nowhere else can so many records be found. The object itself is of interest because of its fineness and regularity. As a test object it is of value, but it suffers from the disadvantage common to all diatoms that there are overlying elements of structure resulting in an image difficult to interpret. No photographs tell us anything with certainty except the periodicity of the structural elements, and this can be determined with objectives of quite moderate N.A. It is, however, important to recognize that while a certain minimum numerical aperture is essential, the full benefit of this can only be realized when sufficient visibility and contrast is secured. To achieve this much has been done in the past with various mounting media of high refractive index, but there are serious practical limits to these methods. Even the use of an objective of 1.6 N.A., with the object mounted in a medium with a refractive index of 2.4 and in contact with a cover glass of 1.7, does not yield an image comparable to those obtainable by using ultra-violet light of moderate wave-length, as was shown at a recent meeting of this Society by Messrs. Trivelli and Lincke (December 16th, 1931).

There is, however, much evidence to suggest both on theoretical and practical grounds, that with such an object no method of illumination by a solid cone of light is likely to yield the best results. It is said that the use of "dark-ground illumination" cannot result in greater resolution, some have tried to prove that it falls far short of that possible of achievement in a transmitted light image. We know of no evidence to support such a contention so far as diatoms are concerned, but it does appear correct to say that by either method of illumination a suitable object can be resolved to the limit imposed by the N.A. of the objective. It is a matter of great difficulty to find an object for comparison, in which elements of structure have equal visibility whether shown as a transmitted light or as a dark-ground

image, and in which the light and dark alternations are equal by both methods. *Amphipleura pellucida* certainly does not fulfil these conditions, but it does approach them in some particulars. It is impossible to deal adequately with a subject of such complexity within the limits of a short paper, but the writers venture to summarize their conclusions as follows:

- (1) That the so-called resolution obtained by illuminating the diatom by a slit stop in one azimuth results in an image which indicates the periodicity only of the structural elements.
- (2) That the disposition of such a slit stop to an angle of about 45° on either side of the frustule results in an appearance suggestive of structure, but this is again only an indication of its frequency.
- (3) That neither of the above methods can elucidate structure and that recourse must be had to the use of either a solid or hollow illuminating cone of rays, in other words, that illumination must be uniform in all directions.
- (4) That a solid cone used under ideal conditions, that is with an ideal object, could fully utilize the aperture of any objective, but that with this diatom the essential contrast or visibility is unattainable and therefore maximum resolution is not achieved.
- (5) That a combination of dark-ground illumination with ultra-violet light does provide a method in which there is close resemblance of image to object.

DESCRIPTION OF PLATE.

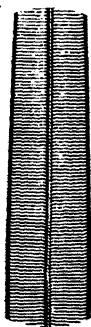
Fig. 1.—*A. pellucida* $\times 1500$. Objective 2.0 mm. Apo. N.A.—1.40. Tube length 250 mm. Realgar Mount. Oblique illumination in the direction of the length of the frustule. Monochromatic blue light.

Fig. 2.—As fig. 1, but with illumination directed across the frustule.

Fig. 3.—As fig. 2, but with greater de-centration of the illuminating beam.

Figs. 4, 5, and 6.—*A. pellucida*. $\times 2000$. Objective 1.7 mm. quartz. monochromat. N.A. 2.4 in 275μ . Dark-ground ultra-violet light illumination with special high aperture quartz condenser. Great care has been taken to avoid effects on the image resulting from de-centration. The annular illuminating cone is of the largest obtainable angle when using an objective of the specified aperture.

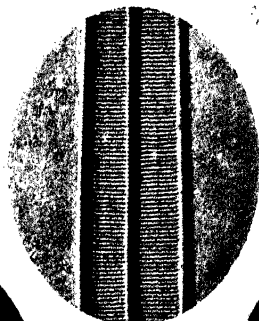
Figs. 7 and 8.—As figs. 4, 5, and 6. These two photographs show the differences between the images when the objective is focussed over any given range. With this object the precise focus cannot be determined. These two images result from a change of focus amounting to 0.1μ .



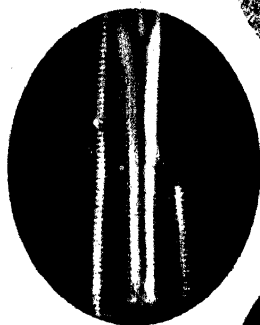
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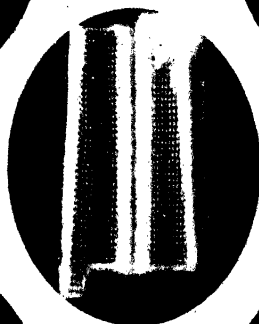
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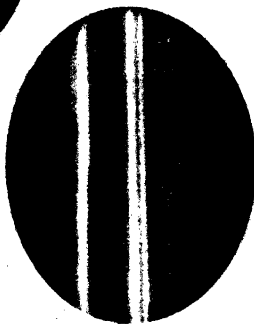
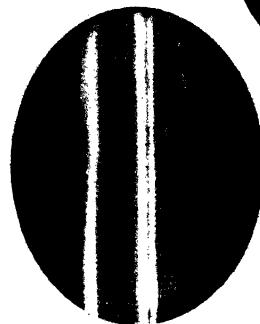
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VII.—SOME NEW THERMOPHILIC ORGANISMS.

577. 41.

By E. HINDLE (Beit Research Fellow in Tropical Medicine).

(FROM THE WELLCOME BUREAU OF SCIENTIFIC RESEARCH.)

(Read December 16th, 1931.)

ONE TEXT-FIGURE.

General.

It is well known that many organisms, especially bacteria, are capable of active life at relatively high temperatures, but so far as I am aware, with one or two notable exceptions, comparatively little experimental work has been done on the artificial production of thermophilic races since Dallinger and Drysdale's classical experiments published in the Transactions of this Society nearly sixty years ago. There are technical difficulties in the way of keeping incubators constant at these high temperatures, apart from the long periods necessary before organisms become acclimatized to such changed conditions, and therefore the upper temperature limits of active life can be studied more conveniently in animals and plants living in hot springs. The origin and mode of life of these thermophilic races are of considerable theoretical interest, and therefore the following observations are published with the object of directing attention to this subject.

During the summer of 1930 I visited the thermal springs at Dax, near Bordeaux, and on the surface of the pool of hot water in the market-place noticed a scum of organic matter floating about. This seemed to consist of blue-green algæ and other filamentous organisms, and some of it was collected and brought back for examination. Having no microscope with me, this material was not examined until nearly four weeks later, during which time it had been kept at ordinary outdoor temperatures. When examined, the only obvious signs of life were various bacteria, but since the temperature of the thermal pool was about 54° C., some of the material was heated to see if any thermophilic organisms had survived. Contrary to my expectations, after mixing some of the original material with boiled tap-water and incubating at 53°–54° C. for one to two weeks, a variety of micro-organisms developed in the liquid, including at least two groups of which there is only one previous record of their active life at such high temperatures.

Thermophilic Amœbæ.

At least two species of amœbæ were observed in the original cultures, one a comparatively large form, 20–30 microns in diameter, and the other a smaller form probably belonging to the genus *Hartmannella*. The larger species soon died out and I have only succeeded in continuing cultures of the latter.

This grows readily on plates of dilute nutrient agar, but it is necessary to keep the plates moist by maintaining a layer of water in the bottom dish, as the water evaporates very rapidly and must be replenished at least every day. The agar used for the cultures was prepared as follows: Agar, 10 gms.; Lemco, 0.5 gm.; sodium chloride, 0.5 gm.; water, 1000 c.c. The mixture was steamed and the pH adjusted to 7.8. After filtration through cotton wool, it was again sterilized and finally poured out into sterile Petri dishes. The proportion of nutrient agar is approximately half that commonly used in ordinary amœba agar, but it was found to be more satisfactory, as there was not such an abundant growth of bacteria and the amœba could be seen more distinctly.

The primary cultures were obtained by placing some of the original material, after incubation for a week at 54° C., on the surface of the agar plate and then incubating at this same temperature for two or three days. A growth of bacteria radiated from the inoculum and after two days' incubation amœbæ could be found along the edges of this growth and subcultured on fresh agar plates. The presence of the amœbæ could readily be detected by examining the surface of the culture under a two-thirds objective of the microscope. As a rule the maximum growth was observed after two or three days and was followed by encystment. The most satisfactory results were obtained by making subcultures every two days, and in this way cultures were maintained for nearly a year, the only difficulty met with being an occasional over-growth of moulds.

The active forms were found to be very susceptible to slight alterations in temperature and in spite of abundant growth at 53°–54° C. for nearly a year, all attempts to raise the temperature at which they would grow, by even 1° C., gave negative results, and when the temperature was raised all active forms quickly disappeared. Encysted forms, however, were unaffected, and as a result the cultures again showed active amœbæ when regrown at 54° C.

The lower temperature limit of active growth of these amœbæ has not been determined, but at 37° C., all cultures failed to grow, although when returned to 54° C., growth again appeared. As in the case of cultures that had been kept at higher temperatures, the amœbæ probably persisted in the form of cysts, for active forms were not seen in cultures that had been kept at 37° C. overnight.

The cysts are able to withstand temperatures ranging from below 0° C.

up to at least 60° C., and dried cysts kept in an unheated shed were found to be alive ten months later.

The morphological details of division and cyst formation in this amoeba have not been fully studied, but from its general structure, and the absence of any flagellate phase, it probably belongs to the genus *Hartmannella*.

As far as I am aware, this is the first definite record of an amoeba showing active life at such a high temperature, although an organism recorded by Issel (1901), as *Pelomyxa villosa*, from hot springs (54° C.) in Italy, probably belongs to the same group. It is necessary to emphasize the statement "active life," since the encysted forms of amoebæ are well known to be able to withstand comparatively high temperatures. R. Ross and D. Thomson (1915), and later D. Thomson and J. G. Thomson (1916), discovered cysts of a free living amoeba on the surface of desert sands in Egypt, which must be exposed to a temperature of at least 65° C. When cultures were made from material from the surface of the sand, various organisms were obtained, including amoebæ and flagellates. There is no evidence, however, that these organisms were capable of active life at high temperatures, but in common with many other animals and plants, possessed highly resistant cysts.

Thermophilic Spirochætes.

The original material from the Dax thermal springs, when reheated to 54° C. in the laboratory, showed the presence of spirochætes, but only in very small numbers. However, when the amount of organic matter in the culture was enriched by the addition of a small quantity of faeces, a much more plentiful growth was obtained, as in the case of other waters treated in this manner (Hindle, 1925, 1931).

Spirochætes morphologically resembling the following were observed in these coprozoic cultures :

- (a) *Spirochæta stenostrepta* Zuelzer, 1911.
- (b) *Spirochæta pseudopallida* Uhlenhuth and Zuelzer, 1921.
- (c) *Spirochæta pseudorecurrentis* Uhlenhuth and Zuelzer, 1921.
- (d) *S. (Leptospira) biflexa* Wolbach and Binger, 1914.

The first three species were only seen in the primary cultures and died out when attempts were made to carry them on in subcultures. They all lived at 53°–54° C., and in addition the varieties of *S. stenostrepta* and *S. (Leptospira) biflexa* were also found in cultures grown at 37° C.

S. (Leptospira) biflexa var. *thermophila* was continued in subcultures for nearly a year and grew readily at 54° C. in tap-water containing one part in thirty of horse serum, and also in Fletcher's medium (Fletcher, 1928). The high temperature at which they were grown seemed to have no obvious accelerating effect on their rate of multiplication, for the maximum growth of the cultures generally occurred after ten to fifteen days' incubation, which is approximately the same time required for the optimum growth of the ordinary *S. biflexa* grown at 30° C.

Morphologically this spirochæte closely resembles ordinary strains of water leptospira, but seems to be serologically distinct from the London tap-water strain, judging by the results of the adhesion test (Brown and Davis, 1927). This test depends on the fact that when a spirochæte is exposed to the action of its specific immune serum, it is altered in such a way that any small particles (blood platelets, bacilli, etc.) adhere to its surface. The rabbit serum used for this test produced a well-marked positive reaction with a London tap-water strain of *Leptospira*, for which I am indebted to Major H. C. Brown, but had no effect on the thermophilic strain. It should be noted, however, that the test with the latter had to be performed on a warm stage at a temperature of approximately 54° C., and it is possible that such a heat might influence the reaction.

For convenience of reference, the name *Spirochæta (Leptospira) biflexa* var. *thermophila* is suggested for this thermophilic race of water leptospira from Dax, but as in the case of most other varieties of spirochætes, it is not distinguished by any different morphological details, but only by its physiological characteristics.

The only thermophilic spirochæte previously recorded is *Spirochæta daxensis*, found by Cantucuzène (1910) also in the Dax thermal pool. This organism, which resembles *S. plicatilis*, was not found in the material I brought back to London, but as this had been at ordinary temperatures for some weeks before examination, many organisms, including this species, may have died out, only the more resistant forms surviving.

It is curious that in the original material from Dax preserved at room temperatures, I have never succeeded in finding any living spirochætal forms, and either these organisms must be extremely scanty or, as I think probable, undergo segmentation into very short forms which are not recognizable as spirochætes.

General Discussion.

The amœbæ and spirochætes living in the Dax thermal waters, are examples of two groups of organisms supposed to be particularly susceptible to the effect of heat, yet both have become acclimatized to active life at the comparatively high temperature of 54° C.* The spirochætes are at least morphologically identical with those commonly found in rivers and pools, and it is only reasonable to assume that the thermophilic races have been derived from individuals to which such temperatures would be rapidly fatal.

With the exception of bacteria comparatively few organisms seem to have become adapted to active life at temperatures above 50° C., although the thermal death point often reaches very much higher temperatures. Many of the bacteria show great adaptability to changes in temperature,

* The temperature of the springs is given as 56° C., but in the laboratory the cultures of amœbæ did not grow at this temperature.

as shown in the following table, which gives a few examples of the ranges through which they are capable of growth. (For further details, see Morrison and Tanner, 1922.)

	Minimum in Degrees C.	Optimum in Degrees C.	Maximum in Degrees C.
<i>B. phosphorescens</i>	0	20	37
<i>B. fluorescens</i> var. <i>liquifaciens</i>	5	24	38
<i>B. subtilis</i>	6	30	50
<i>S. cholerae</i>	8	37	40
<i>B. anthracis</i>	14	37	45
<i>B. tuberculosis</i>	29	38	42
<i>B. fitzianus</i>	—	40	45
<i>B. thermophilus</i>	42	63–70	75–80*

In addition, Setchell (1903) has described bacteria from hot springs in California at 89° C.

B. subtilis is of particular interest, since it is capable of active growth between 6° and 50° C., and has been acclimatized to growth at 57° C. The possibility of the occurrence of mixed races, however, does not seem to have been excluded in the studies of the activities of this organism, and if the cultures contained races with different optimum temperatures it would not be necessary to assume the existence of the active growth of any particular individual through such a wide range of temperature. The existence of different thermophilic races has been proved in the case of the water leptospira (Damon and Hampil, 1929), and it is not unlikely that similar variations would be found in other organisms.

Thermophilic bacteria are by no means restricted to thermal springs but are very widely distributed; they are, however, much more abundant in the tropics, and in sand from the Sahara desert actually outnumbered ordinary forms, whilst in earth from the Antarctic region no thermophilic bacteria could be found (see Le Negre, 1912).

Brief reference may be made to some thermophilic bacteria which are of economic importance in certain fermentation processes. The bacteria producing lactic acid fermentation in milk are able to multiply at 55°–60° C., and although without spores, are only killed by exposure to 65°–70° C. Yoghourt is prepared by the agency of one of these bacilli, which is added to milk heated to 50° C., although subsequently the fermentation is allowed to proceed at 45° C.

Another group of thermophilic bacteria is found in various plant extracts containing sugar, such as beet juice, etc. These bacteria are very active at 45° C., and one of them, *Leuconostoc mesenteroides*, acts on the saccharose and glucose, producing substances which prevent the crystallization of the sugars. Other members of the group are found in fermenting manure, and act on the material at temperatures up to 72° C. Allied organisms are

* According to Bergey (1919).

also found in silos, where the contained vegetable matter undergoes various fermentation processes associated with a rise in temperature. In this case favourable conditions for the diastasic action of the thermophilic bacteria seem to be realized at temperatures of 70°–75° C. Thermophilic bacteria belonging to this group are also used commercially for the manufacture of methane from cellulose.

In addition to bacteria, various other microscopic plants have been found in hot springs. Cyanophyceæ, usually *Phormidium*, have been found growing at 65°–68° C., and occasionally at 75°–77° C. Setchell (1903) also found that the limit of life in siliceous waters (75° to 77° C. for Cyanophyceæ, and 89° C., for bacteria) was considerably higher than the limit in calcareous waters (60°–68° C., and 70°–71° C. respectively), and none were found in acid springs.

Green algæ (*Cladophora*) have been recorded from springs at temperatures of 50° and 57° C. respectively, but it is doubtful if they live at temperatures beyond 60° C. (Sachs, 1864).

In the case of animals some very extraordinary records are found in the literature, such as fish living in springs at 86° C. (Sonnerat, 1774), *Anguillulidæ* at 81° C., at Ischia (Ehrenberg, 1859), frogs at 46° C. (Spallanzani, 1777), etc. Hoppe-Seyler (1875) showed how some of these records may have been obtained, for he observed fish swimming about in a hot spring whose surface temperature was 44°–45° C., but at 13 cm. below the surface the temperature was only 25° C.

In the case of other Metazoa, there is a record of a *Stratiomys* larva living at 69° C. in hot springs in Colorado (Griffith, 1882), but in spite of the extraordinary resistance of some insect larvæ, there is considerable doubt about this record. It is of interest that A. S. Packard, who examined this larva, stated that it was identical with one from the Borax Lake, California, where it lived in water of almost concentrated salinity.

In spite of these various records, at the present time the only animals which are known with any certainty to lead an active life at temperatures above 50° C., all seem to belong to the Flagellata and Rhizopoda, although Ciliates, Rotifers and Tardigrada approach this limit.

The Thermal death-point is, of course, very much higher in the case of both plants and animals.

Filterable viruses, which are possibly examples of the most elementary living organisms, show different degrees of resistance, ranging from such a comparatively thermolabile virus as rabies (50° C. for 60 minutes, or 45° C. for 24 hours), yellow fever with a death-point of 55° C. for 10 minutes wet, and 60° C. for 20 minutes dry, up to 80°–90° C. in the case of Mosaic disease when wet, and higher temperatures when dry. Bacteriophage is destroyed at temperatures of 60°–80° C. wet, but when dry resists 100° C. or possibly 135° C.

Bacteria also show considerable variation in this respect, some of the parasitic forms, such as gonococcus being extremely susceptible to variations

in temperature, whilst a very large number, and especially the spore-bearing members of the group, are able to withstand very high temperatures. Thus the spores of the anthrax bacillus require at least 3 hours *dry* heat at 140° C. to effect death, although 1 hour of *moist* heat at 100° C. is fatal. *B. diphtheriæ* in a liquid suspension is killed in a few minutes at 60° C., but when dry withstands 98° for 1 hour. Tetanus spores resist boiling for a few minutes.

In general, a *dry* heat of 160° C. is considered necessary to ensure sterility, although long-continued boiling at 100° C. for several hours is also effective.

In the case of animals, there are comparatively few records of any high thermal death-points and those few are confined to animals which form cysts capable of withstanding drying.

Doyère (1842) has recorded that Rotifera and Tardigrada, after *long drying*, may be heated to 120° C. without all dying, whilst 50° C. is fatal in water. Dallinger and Drysdale (1874) have recorded maximum temperatures of 65°–131° C. for the spores of flagellates, but there is some doubt about these records, as in their experiments the possibility of subsequent contamination of the fluids is not absolutely excluded. Reference has already been made to some of the Protozoa which have been cultured from desert sand, and many other groups of animals occurring in tropical deserts, either as spores or in a state of æstivation, must be capable of withstanding temperatures exceeding 60° C.

Resistance to high temperatures unquestionably depends on several factors, but in the case of organisms which can be dried, such as many bacteria, and also in spores and cysts, there seems to be some correlation between the degree of dryness, and the power to withstand high temperatures. The same organisms generally tolerate higher temperatures when dry than in the presence of water. A suggestive parallel may be drawn between the coagulation temperatures of egg albumen mixed with different percentages of water as shown in the following table :

Egg Albumen.	Coagulation Temperature.
In aqueous solution	56° C.
+ 25 p.c. water	74°–80° C.
+ 18 "	80°–90° C.
+ 6 "	145° C.
Without water	160°–170° C.

In the case of organisms capable of active life at high temperatures the problem is much more complicated, but even in these cases there is some evidence in support of the view that reduced water content raises the thermal death point. Thus Davenport and Castle (1896) record experiments by Hamaker, who found that if Ciliates were acclimatized to solutions of high osmotic pressure, their bodies became smaller and their thermal death-point was higher. It may also be recalled that the *Stratiomys* larva, found living in a hot spring, was stated by Packard to be the same as one collected from a borax lake.

The hydrogen ion concentration must also be of very great importance,

since both the critical inactivation temperature and temperature coefficient of enzymes are affected by this factor. In many enzymes the critical inactivation temperature (that at which the enzyme is half destroyed in an hour) lies between 50° and 70° C., although dry emulsin (101° C.) and dry lipase (151° C.) are notable exceptions. The difference, 14°–18° C. between the upper temperature limits of life in siliceous and calcareous waters, noted by Setchell (1903), is probably due to differences in pH.

Another significant factor is the amount of dissolved oxygen in the liquid, since this diminishes as the temperature rises, and it is of interest that many thermophilic bacteria, such as those fermenting manure, are anærobic. Moreover, Rabinowitsch (1895) found a thermophilic bacterium, which, although growing aerobically at 50° C., would only grow anærobically when kept at 37·5° C.

The most remarkable observations on this subject still remain Dallinger and Drysdale's account of the production of thermophilic strains of three species of flagellates, *Monas dallingeri*, *Dallingeria drysdali*, and *Tetramitus rostratus* (see Dallinger, 1887). During the course of nearly seven years they were able to raise the temperature at which these animals would live from about 15° C. up to 70° C., and the experiment would have continued longer but for an accident to the incubator containing the cultures.

It is of interest to recall the difficulties that were encountered in this experiment. The flagellates could be raised fairly rapidly from 15°–21° C., and at the latter temperature multiplication was more rapid, but it was found that better results were obtained by raising the temperature very slowly. In the first two months the temperature was elevated 3° C., and during the next two months approximately one degree each month. Then from 21° to 23° C. less than one degree per month. At 23° C. there was a great falling off in numbers but no morphological change, and after a week they recovered and were kept at this temperature for two months. They were then raised about half a degree and another diminution occurred, but not so marked as before, and the cultures recovered after four days. During the next five months they were slowly raised up to 25·5° C.

This seemed to be a critical point, for it was only by altering the temperature backwards and forwards between 25° and 25·5° C. for several weeks that forms were obtained which would survive at the higher temperature. Beyond this point and during eight months it was found impossible to raise the temperature even less than half a degree without obvious ill effects. After two or three months they were more vacuolated than usual, but when conjugation occurred vacuolation disappeared and eventually the three species of flagellates became normal in appearance and were slowly raised to 34° C. during the next nine months. Beyond this point no advance could be made for another nine months, during which time increased vacuolation reappeared and in turn disappeared when the flagellates were kept three weeks at 34·5° C. and then raised to 39° C. without any difficulty in fourteen weeks. Then there was slightly increasing difficulty

up to 42°C . which took two months. During the next three months a slight vacuolization took place and then a further advance was made until, after seven months more, 58°C . was reached.

This was a very critical point and for twelve months no advance could be made, at the end of which period a sudden increasing growth of vacuoles was noticed in some individuals on raising the temperature to 58.5°C .

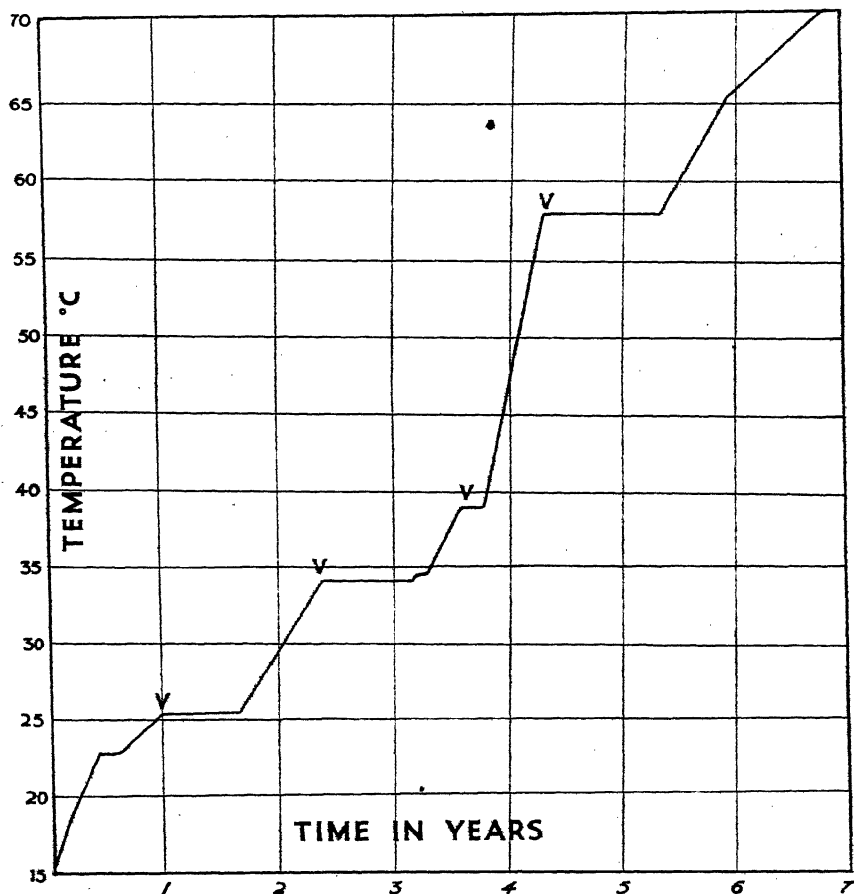


FIG. 1.—Curve showing the development of thermophilic races of flagellates, plotted from Dallinger's results. V, vacuolization of protoplasm.

and after a month all the flagellates showed this vacuolated appearance. When these appeared the temperature was gradually raised about 2°C . in a month and the vacuolization again disappeared. The temperature was then raised fairly rapidly, about one degree at a time up to 65.5°C ., then more slowly to 68°C ., and came to a dead standstill at 70°C .

I have plotted these results in the form of a curve (fig. 1) and it will be seen that there are a succession of critical points at each of which marked

vacuolization of the protoplasm was observed, and only after this had disappeared was further advance possible. The results support the view that at each of the so-called critical points indicated in the curve, it was necessary to wait until a mutation appeared which was capable of withstanding a higher range of temperature. Accordingly, each critical point might be considered as the upper temperature limit of the strain produced at the next critical point below it, and it is noteworthy that these thermophilic strains, developed in the laboratory, died when kept at 15.5° C.

Jollos (1921), in the case of *Paramecium*, has shown that different strains, or clones, cultured from single individuals, present considerable variation in the temperature range through which they will live, four of his clones showing the following different ranges: 6°–37° C., 8°–32° C., 12°–35° C., and 12°–29° C. As a general rule no lasting changes were produced by exposure to high temperatures, except when treated during the later phases of conjugation, when the effects were found to be permanent in a small percentage of cases. Such changes were found to persist during many generations by conjugation, and therefore may be considered as true mutations.

An interesting thermal mutation has been recorded by Banta and Wood (1928) in *Daphnia longispina*. In connection with the authors' studies of this crustacean, cultures had been continued in the laboratory for some years at 20°–21° C., which was found to be the optimum temperature. Suddenly one out of seven sexually produced clones developed individual characteristics, with an optimum temperature of 27° C., and was unable to reproduce at 20° C. or lower. Moreover, this thermal race was only killed at 43° C., whilst the parent stock was killed at 38° C. This striking example of a thermal mutation was only discovered more or less accidentally, and it is not improbable that thermal mutations of this nature are by no means uncommon. Their occurrence would afford a possible explanation of the development of the various thermal races of animals and plants, which, as a rule, resemble other forms living at ordinary temperatures, and are only distinguished by their capacity for active life at comparatively high temperatures.

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535. 91. VIII.—A METHOD FOR VERTICAL MICROPROJECTION WITH
THE CARBON ARC AS ILLUMINANT.

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(Read May 18th, 1932.)

TWO PLATES.

THE microprojection of a subject for reconstruction work is best accomplished by using an apparatus affixed in the vertical position, projecting the image upon a horizontal table for ease in drawing. The upright position eliminates the necessity of a mirror to bend the light rays which would be necessary in the case of an instrument operating in the horizontal position, and obviates the undesirable correction of the inverted image so obtained. In the past the only types of apparatus fixed in the vertical position used incandescent bulbs as the source of light. These instruments were thoroughly successful for work of low magnification, but wholly inadequate for use with the higher powers of magnification, as called for when involving the use of oil immersion objectives. The failure of the instrument mainly lay with the light source, which lacked the necessary power of penetration for projection.

After much experimentation and at the instance of Prof. J. L. Bremer, we sought an instrument that would overcome our difficulties. The attributes of the instrument we sought may be summarized as follows: It should be compact and permanently aligned, must have an adequate light source, and must allow of easy adaptation to our existing stand, and when affixed, be rigid in a true vertical position. From the many admirable instruments on the market, that which answered our requirements was a Bausch and Lomb Microprojector (No. 4354 AA), which is compact and permanently aligned as a single unit; it has an automatic arc lamp. The condensing lens system consists of four units. First, a 60 mm. aspheric condenser acting as a collecting element, directly in front of the light source. Second, three condensers mounted in separate swinging arms, adjustable by rack and pinion, which serve as substage condensers for the range of objectives used. An efficient heat absorbing glass screen is mounted just back of the substage on a swinging arm, so that it may be thrown out of the axis when used with preparations not susceptible to heat. A microscope is carried on the same general base and the tube is focused by coarse and fine adjustment. This microscope is fitted with a triple (or quadruple) nose-piece

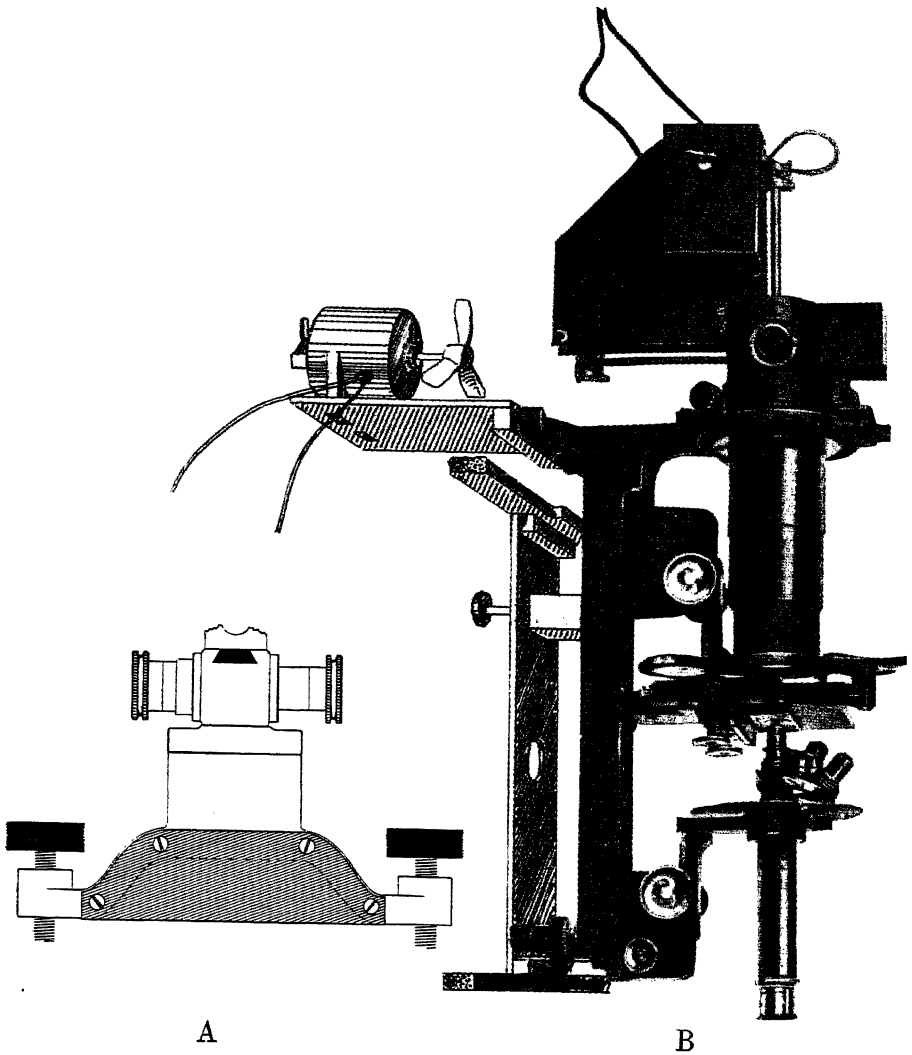


FIG. 1.

- A. Microprojector in vertical position screwed to vertical plate of carriage, and showing fan on its platform attached to back legs of the projection apparatus.
- B. Front view of front legs of microprojector with machined flat plate (cross-hatched—screwed in position).

and the tube is hinged so as to swing laterally out of the optical axis to permit projection of the large field when using Micro Tessars. The instrument is also fitted with a mechanical stage.

This apparatus is designed for use in the horizontal position, and we were at once faced with difficulties when attempting to use it for vertical projection. When using the machine normally, in the horizontal position, it is the horizontal carbon that burns and forms the crater which is the main centre of the source of light. The products of combustion escape as gas by the chimney provided. This is caused by the design which allows the draught caught by the heat of the flame to act as this scavenging agent. When the instrument was turned to the vertical position, this normal draught was interfered with, the crater became fouled, and carbon particles which normally fall harmlessly to the table now dropped on the large aspheric condenser, screening the light rays, which were materially lessened in this position.

Prof. Bremer considered the possibility of establishing an artificial draught with the instrument in the vertical position, which would have the same direction as the normal up-draught, with instrument in the horizontal position; therefore, he designed a platform carrying an electric (vibrationless) fan, mounted so as to produce the desired draught (*see* fig. 1, A). This platform was bolted to the rear supports (feet) of the base in position to hang vertically downward in the normal state of the instrument, becoming a horizontal shelf in the vertical position. To this shelf the fan motor was firmly attached. At first a funnel covered the fan directing the air current horizontally towards the crater (with the instrument in the vertical position), and this draught was aided by lengthening the chimney with a tube. Both these aids proved superfluous, the instrument working better when they were removed. A very slight current of air activated by the fan was sufficient to overcome the fouling of the crater, and prevent carbon particles from fouling the collecting condenser. Later it was found that the fan increased the brightness of the light even in the horizontal position.

For easy use for projection the instrument with this fan attachment is carried, in this laboratory, on a stand (fig. 2) devised several years ago, and already used for incandescent projection, and for carrying a motion picture camera in vertical position. The stand is composed of two firmly affixed parallel vertical shafts which are attached below to the floor and above by brackets to the wall. These round shafts pass through a horizontal table upon which the image is projected for tracing. A carriage is made by two parallel horizontal bars with bushed bearings which slide on the vertical shafts of the stand, and are joined in the middle by a vertical steel plate. On the lower end of this plate is a steel flange, trued to the horizontal, and in the mid-line is a slot through which the anchorage screw is passed. Other screws in the bearings can hold the carriage at any point (fig. 3).

The microprojector has a machined, flat plate screwed to the front of the front legs of the cast base (shown by fig. 1, B). Its face is at true right-

angles to the optical axis. The apposition of this plate to the trued flange on the mounting insures the attachment of the instrument in a true vertical position laterally.

A tapped steel block is permanently affixed to the underside of the base of the projector. This block is so adjusted that when its face is against the steel plate of the mounting, the instrument is in a true vertical position in the forward-backward position. Therefore, all that is required to lock the projector in a firm, true, vertical position is the passing of a milled screw through the slot of the mounting plate into the tapped block. This method is simple, durable, and effective, and does not interfere with the projector if it is desired to use it for microprojection in the horizontal position as when demonstrating to a class. If used horizontally on a table the shelf bearing the fan and motor can conveniently hang down over the table-edge. Other instruments used on the stand are fitted in the same way to the slot in the steel plate, so that merely by the turning of the single anchorage screw one may replace another.

The advantage of this sliding adjustable mounting is obvious. By raising the carriage the projected image can be magnified to any desirable extent. The actual magnification for any lens system at any distance can be determined by the use of the micrometer scale, and can be readily returned to, if the height of the carriage from the table has been noted.

The necessary control switches are at hand on the table, and a master switch and pilot light are attached to the distant wall. Against the face of this wall the counter weight rises and falls, counter-balancing the instruments used on the carriage, to which it is attached by cords and pulleys. The whole is surrounded by heavy, light-proof curtains which slide on a rod affixed free of overhead roof and valance. The space between this valance and the curtain rod acts as a light baffle and provides an air space which allows ventilation. This arrangement is so efficient that even on the hottest day, with the curtains drawn and the arc burning, it is possible to work without feeling unduly hot. The resistance coil for the arc lamp is attached outside the curtains, where also is fitted another pilot light, indicating that the master switch is "on." This is a precautionary measure to prevent the worker from overlooking to switch "off," which is quite possible when a carbon is burnt out. The unit, as a whole, is shown by the photograph (fig. 2), and enlarged view of microscope unit by fig. 3.

Summary.

A method devised whereby a standard microprojector is altered to allow of use in the vertical position. The alteration is mainly accomplished by the establishment of an artificial draught to overcome the reversed position of the carbon arc which is the light source. This allows a high magnification and is very efficient even with oil immersion 2 mm. objective, and ocular 10. The attachment of the instrument to the stand is accomplished by the addition

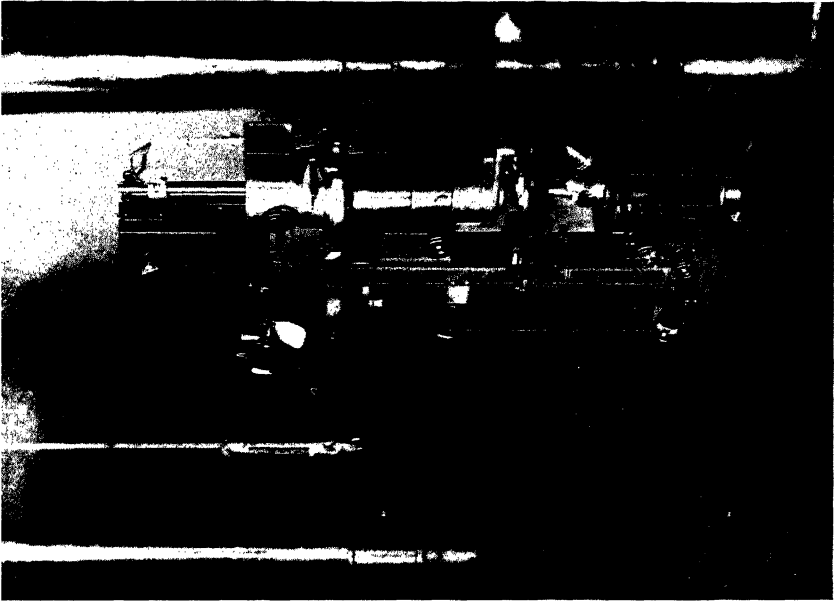


FIG. 3.
Microprojector, with fan in position on carriage of stand.



FIG. 2.
(General view of stand for microprojection.)

of a faced horizontal plate and a steel block bored to receive a screw. The plate fits against a similar one on the mounting, thus insuring the vertical position laterally. The vertical position in the other direction is accomplished by the steel block attached permanently to the instrument base and screwed by a milled hand-screw to the mounting plate.

The mounting is carried by four bearings on the vertical parallel shafts of the stand and can be anchored in position by hand-screws. A counter-balance compensates for the weight of the instrument and mounting. The whole ensemble is curtained for the exclusion of light, and is adequately ventilated. A system of pilot lights indicates when switches are "on" and prevents carelessness, thereby eliminating a fire hazard. The whole unit is simple and effective, does not require any skilled knowledge of microscopy, and may be regarded as entirely "foolproof."

612. 44. IX.—COMPARATIVE HISTOLOGICAL STUDIES OF THE THYROIDS
AND PITUITARIES IN FROG TADPOLES IN NORMAL AND
ACCELERATED METAMORPHOSIS.

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of London).

(Read May 18th, 1932.)

TWO PLATES.

I.—*Introduction.*

EXPERIMENTAL investigations upon amphibian metamorphosis have revealed the significant influence of the thyroid and pituitary upon the changes involved. Both these glands accelerate these changes, but the removal of either gland from tadpoles prevents their complete metamorphosis. Extirpation of the thyroid causes hypertrophy of the pituitary, and in the absence of the latter the thyroid remains rudimentary. Moreover, hypophysectomized and thyroidless tadpoles can be made to change by treatment with thyroid (Allen, 1919), whilst axolotls, both normal and thyroidectomized, will metamorphose when given suitable injections of an extract of the anterior pituitary (Hogben, 1923; Spaul, 1924, 1930). These facts indicate the interrelationship of the thyroid and pituitary, but at the same time suggest their ability to act independently upon metamorphosis.

Comparative studies of the metamorphosis of tadpoles accelerated by either thyroid or anterior pituitary show distinct differences in relation to iodine and in their quantitative and qualitative responses, and there is also a differential tissue response (Spaul, 1928). Axolotls are able to utilize iodine in metamorphosis when thyroid but not pituitary is administered (Spaul, 1925). These examples provide further favourable evidence of the vicarious functioning of these glands. On the other hand, Uhlenhuth (1927) concluded, from histological studies of the thyroid of the salamander in normal and pituitary accelerated metamorphosis, that the anterior pituitary exerts its influence through its stimulation of the thyroid (Uhlenhuth and Schwartzbach, 1927). Ingram (1929) found histological changes in the thyroids of larval forms of *Rana clamitans* and *R. pipiens* after grafting anterior lobe pituitary, which he regarded as an expression of increased activity of the gland.

However, no corresponding studies of the pituitary have been made, and in view of the importance of the gland in metamorphosis, its histological record during these changes would be an essential contribution to a more complete understanding of the interrelationship of the thyroid and pituitary and their behaviour in metamorphosis. In this paper a comparative histological study of these glands in the tadpole, during both normal and accelerated metamorphosis, has been undertaken, and the results considered in relationship to these problems.

II.—*Material and Methods.*

The material consisted of tadpoles of *Rana temporaria* which had been subjected to suitable treatment with thyroid and anterior pituitary until metamorphosis had been produced under standardized environmental conditions. A parallel series of controls changing normally to the adult form was kept. Others given iodine treatment were also used.

Specimens at the same stage of development, collected from various sources, were placed in dishes containing 100 c.c. of tap water (ten in each). The following series were arranged :—

- (1) 1 c.c. of standard thyroid extract was added, and after 24 hours the water was changed ; this was repeated two days later ;
- (2) tri-weekly injections of 0.1 c.c. of 20 p.c. extract of anterior lobe pituitary ;
- (3) specimens placed in iodine solution : (a) 1 c.c. of saturated iodine solution in water in 250 c.c. tap water, and (b) 1 c.c. in 400 c.c. tap water ;
- (4) tri-weekly injections of 0.1 c.c. of a 10 p.c. extract of the posterior lobe of the pituitary ;
- (5) controls.

The animals were given no food during the period of the experiment, and the water was changed every other day.

Similar series were arranged for specimens at other stages of development.

Tadpoles from each series at definite stages up to the completion of metamorphosis were selected periodically and fixed in Bouin's fluid. Also controls were fixed at the same time after the commencement of the experiment as the accelerating forms. A few were fixed in Suza mercury fixative, but, as a general rule, Bouin fixation was found sufficient for the comparative purposes of this work.

After embedding in wax, sections (4 to 5 μ) were cut in three planes—sagittal, horizontal and transverse—through those regions containing the thyroid and pituitary glands, and stained with hæmatoxylin and eosin, hæmatoxylin and Orange G., hæmatoxylin and Biebrich Scarlet, hæmalum, and Mallory's triple stain. The differentiation of the pituitary was insufficient with these stains, with the exception of Mallory. In this case the maximum

effect was not produced, but by modification a complete differentiation of the anterior pituitary cells was eventually obtained. The following formula was finally adopted :—

Solution A	(0.5 p.c. aqueous acid fuchsin)	...	6 minutes.
„ B	(1 p.c. phosphomolybdic acid)	...	4 „
„ C	$\left\{ \begin{array}{l} \text{Aniline blue 0.7 gm.} \\ \text{Orange G. 0.4 gm.} \\ \text{Oxalic acid 2 gm.} \\ \text{Water 100 c.c.} \end{array} \right\}$	...	7 „

It is of interest to note that no difference was observed in preparations of the ox pituitary when either this modification or the normal Mallory stain was used. The pituitary was also studied by using the iodine technique (Spaul and Howes, 1930). (See pl. II.)

III.—Observations.

A complete survey of the thyroid and pituitary of the normal animals and those subjected to the various agents was thus made, so that a histological comparison between the glands of the different animals at the different stages up to metamorphosis was possible. A comparison was made between the glands of the accelerated forms and those of controls fixed at the same interval of time after the beginning of the experiment. This was done to allow, if possible, for any variation that might be due to the longer interval required by the control to reach the same stage of development. Hence, using two sets of controls, a comparison (1) at the same stage, and (2) after the same experimental period, was possible. In addition, the influence of (a) difference in the rate of acceleration due to the size of dose, (b) period of treatment, and (c) the stage at which treatment commenced, was especially noted.

Thyroid.—The stage with hind-limb buds was the first examined in the controls. The thyroids were small, and composed of small vesicles consisting of a single layer of flat epithelial cells surrounding a mass of colloid. This colloid appeared homogeneous with no vacuoles. A few undifferentiated epithelial cells appeared at times towards the centre of the gland. In succeeding stages the vesicles increased in size and number, so that the gland itself became larger. Cubical epithelial cells predominated when the hind limbs had three well-developed joints, and immediately before metamorphosis these cells were mostly columnar, with the vesicles full of colloid (pl. I, B). Droplets, staining with Mallory a similar blue to that of the colloid, were sometimes present in the apical part of the cell. During metamorphosis numerous vacuoles appeared at the periphery of the colloid masses. The colloid was apparently less dense, with a tendency to be granular. Shrinkage was evident in some cases. The epithelium, of which there was never more than one layer surrounding the vesicles in *R. temporaria* tadpoles, remained



FIG. A.



FIG. B.



FIG. C.

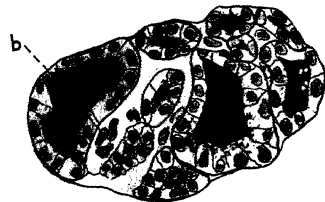


FIG. D.

columnar or cubical, which was similar to the conditions observed by Z. Mayerowna (1922).

In *thyroid-fed* animals there was greater variation in size, and extreme vascularity was usual in advanced stages. Almost all specimens, at stages from the first appearance of the three joints of the hind limb up to metamorphosis, had cubical or flattened epithelial cells, irrespective of the quantity of thyroid given (pl. I, A). In only one case was columnar epithelium observed near complete metamorphosis. Definite shrinkage or vacuolation of the colloid occurred. The invariable blue-staining reaction of the colloid in the controls was not obtained, there being blue or red, or the blue confined to the centre of each mass, with orange borders. Further, in advanced stages the colloid might be granular.

The thyroids of tadpoles receiving injections of the *anterior pituitary* varied also (pl. I, C). As a rule, the vesicles were of medium size, with frequently, in both early and late stages of metamorphosis, a group of undifferentiated epithelial cells in the inner part of the gland. The cells were usually cubical, but might be partly flattened in some and columnar in others. The colloid might be contracted or even absent, but often filled the vesicles. Vacuoles, if present in the early stages, were few, but at metamorphosis they were either numerous, few, or altogether absent. An even greater variation of the staining reaction of the colloid was found.

The progress of metamorphosis was inhibited, as expected, in those tadpoles given injections of extract of the *posterior lobe of the pituitary* (Spaul, 1925). They did not advance beyond the stage in which the hind limbs were three-jointed, during the period required for completion in those accelerated. Their thyroid glands were small, the vesicles round and lined by flattened epithelium. The colloid was contracted or absent, showed no vacuoles, and stained blue with Mallory, but sometimes had a granular appearance, which constituted the main distinction of the gland from that of controls at the same stage of development.

The thyroids of those tadpoles in the stronger *iodine* solution (pl. I, D) differed very little from those treated with thyroid, the cells being cubical or very flat, with variable colloid which was either contracted or filled the vesicles. Vacuoles appeared in some. The effect was less in the weaker iodine solutions, the cells being, as a rule, cubical or columnar in advanced stages, although flattened cells were found in some.

Summarizing these observations, the most noticeable feature is the variability in all cases, but in spite of this a distinct demarcation exists between the groups. The variation can be accounted for to a large extent by differences in dosage and age when initially treated, and also by the individual variation of the animals themselves.

The thyroids of those completing metamorphosis under thyroid treatment are clearly distinct from those of controls at the same stage, showing a decided tendency to resemble controls at an earlier stage of development. It would appear that these cells have not completed the cycle characteristic

of the controls. On the other hand, the colloid appears to be less in amount and more dense. Similar observations were made by Uhlenhuth upon the thyroid of salamanders treated with iodothyrene (Uhlenhuth and Schwartzbach, 1927). The thyroids of those animals metamorphosing under the influence of anterior lobe of the pituitary are not so clearly differentiated from those of the controls. The latter are fairly consistent compared with the fluctuations observed in the others. Many have cubical cells, but others flattened or columnar, whilst the colloid varies in quantity, density—hence staining capacity—vacuolation, and the extent of shrinkage. No definite correlation between the state of the colloid and the structure of the cells is possible. Hence there is not the close agreement between the glands in this case comparable to that recorded by Uhlenhuth and Schwartzbach (1927) between the thyroids of controls and anterior lobe pituitary treated *Amblystoma tigrinum*.

Pituitary.—Here again the pituitary glands of the controls were examined at stages from the first appearance of hind limbs up to the completion of metamorphosis. Three distinct types of cell were observed in the anterior lobe of the pituitary with the modification of Mallory's triple stain, but the differentiation between them is not so clear as that found in mammalian pituitaries (Cooper, 1925; Spaul and Howes, 1930). The cells observed were (1) oxyphil, in which the cytoplasm stains scarlet or orange; (2) basophil, which have blue-staining cytoplasm; and (3) cells which are intermediate in staining reaction between the others, grading from an orange-grey to a blue-grey colour for the cytoplasm. The oxyphil and basophil cells are very similar in structure, having a large nucleus of variable staining capacity with one or more nucleoli, which are frequently oxyphil. Compared with the mammal, the cytoplasm, which is granular, is scanty. There are at least two kinds of granules, coarse and fine. The former are very dark red in oxyphil cells and dark blue in basophils, and closely surround the nucleus, but clumps of them are also found in different parts of the cytoplasm and towards the periphery. The fine granules stain either bright red or bright blue, and are distributed evenly throughout the cytoplasm. As regards the intermediate cells, some have a similar structure to the oxyphils and basophils, excepting the grey-staining reaction of their fine granules and the dark brown of the coarse granules, whilst others have no coarse granules and may be altogether smaller. The weakly-staining oxyphil and basophil cells found in the ox (Spaul and Howes, 1930) could not be distinguished in these intermediate cells, but two kinds of neutrophils were noted in some sections of material fixed in Suza. The distribution of these three types of cell was not constant, but they tended to conform to some kind of plan, with the basophils concentrated towards the inferior and central part of the lobe.

The cells of the *pars intermedia* are basophil and neutrophil, and structurally resemble the basophils of the *pars anterior*. The *pars nervosa* consists chiefly of neuroglia cells and fibres, staining in a similar manner to

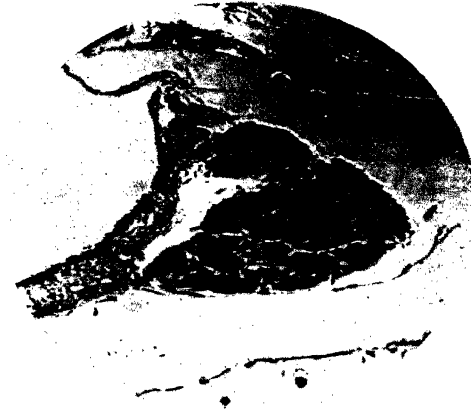


FIG. E.

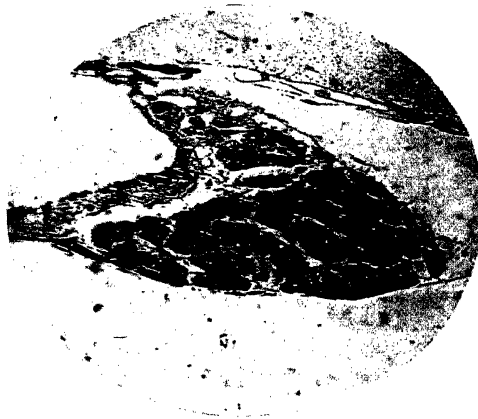


FIG. F.



FIG. G.

the pars intermedia of the same animal. In both cases, however, the nuclei may vary in colour. No further reference will be necessary to the posterior lobe of the gland, as its condition remains approximately the same throughout treatment with the various agents.

Young stages of *control* animals had rather small and flattened pituitary glands. The oxyphil and basophil cells, about equal in number, were a dull red and dull blue respectively, owing to the weak affinity of their fine granules for the stains. Numerous large dark granules were present round the nuclei of all cells. As older stages were examined (pl. II, F), the gland became larger, with the oxyphil cells a brighter scarlet and the basophils a deeper blue, but the proportion of each type of cell remained approximately the same as that in the glands of young animals, so far as could be ascertained.

In *thyroid-fed* animals the structure and proportion of oxyphil, basophil, and neutrophil cells in the anterior lobe of the pituitary appeared to be similar to the controls. However, a marked alteration in the staining reaction of the lobe was observed (pl. II, E). All types of cell tended to be more basophil, the cytoplasm of oxyphil cells being red to orange, that of the intermediates grey to blue, whilst the basophils were a deep blue.

Again, in the anterior lobe of those given *anterior pituitary* extract, the structure and proportion of the different types of cell appeared to correspond with the controls, but there was a definite oxyphil reaction (pl. II, G). The cytoplasm of the oxyphils was more intensely stained than in the controls, whilst the intermediates were graded from an orange-yellow to grey. Few basophils appeared normal, many being purple, and in some cases they seemed to have lost their affinity for stain. The intensity of the effects appeared to be dependent upon age and dosage.

The condition of the pituitary in tadpoles kept in *iodine* solutions, also those treated with an extract of *posterior lobe pituitary*, resembled in general that of the corresponding stage of control animals.

In investigations upon the distribution of biological activity in the ox pituitary, Spaul and Howes (1930) applied an iodine leucobase technique based upon chemical knowledge of active extracts of the anterior pituitary which enabled them to associate the oxyphil cells with metamorphic activity. Howes has more recently modified this technique by substituting cyanosin for the leucobase of malachite green as the medium for emphasizing the differential adsorption of the iodine.

In view of the established influence of the pituitary in metamorphosis and the changes in the animals' pituitaries recorded here, it was considered that this technique would be of assistance in the interpretation of those changes. Sections from absolute alcohol were treated with:—

(1) 4 p.c. iodine in absolute alcohol, 3–5 hours; (2) 10 p.c. iodine in potassium iodide solution, 2 days; (3) wash and 1 p.c. aqueous phosphomolybdic acid, $\frac{1}{4}$ -hour; (4) wash quickly and 1 p.c. aqueous solution of cyanosin at 55° C., 1 minute. All the cells were stained pink, while the oxyphils were shown, by comparison with sections stained with Mallory,

to be a deeper pink. The large granules present in the cells appeared dark brown.

In controls the intensity of this reaction increased with age up to metamorphosis. In thyroid-treated animals the whole was paler at any corresponding stage, whilst the differential effect between the oxyphils and others was small. In the anterior pituitary-treated animals the effect was more marked than in the controls, the oxyphils being deeply coloured.

This response serves to emphasize the difference between the animals treated with anterior pituitary and the controls, and still more that between the thyroid-fed and anterior pituitary-treated animals.

These results indicate variation in the staining affinity of the cytoplasm of the cells of the glands which are correlated with the treatment to which the animals are subjected. On the other hand, no definite evidence of structural alteration in the cells or the gland itself, or variation in the number of the different types of cells, is forthcoming. The nuclei appeared to be in a resting phase throughout, with lightly-staining chromatin and nucleoli and no indication of mitotic chromatin figures.

IV.—*Discussion.*

The most interesting feature of these histological studies is the definite but different reaction, indicated by the affinity for acid and basic stains, observed in the cytoplasm of the pituitary during metamorphosis. This is dependent upon the accelerating agent given. However, the extent to which the changes observed in the glands indicate the variations in secretory activity is a problem upon which little can be said at the moment. There is not a cycle of changes comparable to that observed in the thyroid, nor has the histological technique been such as to permit a detailed and accurate study of the cytoplasm. The only variations in the cytoplasm that have appeared from the preparations made here concern its staining affinity. Alterations in the granular nature of the cytoplasm, or other changes likely to be interpreted as indicative of secretory activity, have not been obtained. A more comprehensive study would be needed and a more complete study of the pituitary of other species in other groups required before any conclusion could be reached regarding the sequence of changes indicative of secretory activity.

It has been suggested that oxyphil and basophil cells represent different functional phases of a particular secretion. Others suggest they are responsible for separate activities and, instead of being interchangeable, have a separate derivation. It is also suggested that these cells are recruited from the neutrophil cells, but from these observations, and in the absence of cell-division, it would appear that they retain their individuality, and it is merely the cytoplasm that is influenced by the stimulus. These observations throw no light whatsoever on the problem of the relationship of the cells to one another, and the extent to which they can be said to indicate

different functional activities of the cells. A further complication is the probable presence of other active factors in the anterior pituitary (growth and gonad factors), and no evidence exists as yet for associating any particular activity with any particular type of cell, except the work of Spaul and Howes, in which the oxyphils are indicated as being possibly associated with the metamorphic activity. In this respect the reaction obtained with the iodine technique is significant in that it is most intense in acceleration produced by anterior pituitary extracts.

As regards the thyroid, the cycle of changes observed, when the rate of metamorphosis is increased by anterior pituitary, is essentially the same as the controls. The characteristic condition of columnar cells and vacuolated colloid in the final phase of the controls, however, shows considerable variation in that either the cells or colloid may not entirely have reached that stage. Uhlenhuth concluded, having observed a similar cycle in the *Amblystoma* thyroid, that the pituitary stimulated the thyroid and so brought about metamorphosis. However, if this were the case, more thyroid would probably be required than normally to produce acceleration (as in acceleration by thyroid treatment), and hence indications of hyperactivity of this gland might be expected. The variation noted here cannot justifiably be interpreted as a sign of hyperactivity—in fact in many cases the thyroid lags behind, although consideration must be given to the inadequacy of these preparations in assessing any quantitative action. It might well be that the pituitary stimulated metamorphosis and the thyroid proceeded to develop under the same stimulus, in unison with the remainder of the organism, so that it presented a similar histological picture at the completion of accelerated metamorphosis to that at the completion of normal metamorphosis.

Apart from the changes in the thyroid, there is the marked oxyphil response in the pituitary, which suggests that both glands are stimulated as well as metamorphosis. This contrasts with the undeveloped condition of the thyroid and the basophil reaction of the cells of the pituitary in thyroid acceleration, when, if basophilia is indicative of reduction of pituitary activity, the glands appear to be inhibited, and thyroid effects metamorphosis by direct action upon the tissues.

In any case, it is evident that the endocrine balance is disturbed, but in view of these histological studies it is doubtful to what extent inferences can justifiably be made upon the exact mechanism of the stimulus of either upon metamorphosis. Undoubtedly they are interrelated, but whether the metamorphic stimulus of the pituitary is direct or associated with the thyroid is a point demanding not merely a study of the thyroid or pituitary alone, but a complete survey of these glands in amphibia undergoing accelerated and normal metamorphosis, together with studies of these glands in neotenuous forms and the results of experimental investigations.

It is interesting to note at this stage that arrested development of the thyroid results from hypophysectomy, and hypertrophy of the pituitary

results from extirpation of the thyroid. In view of this interrelationship, the condition of the thyroid in thyroid acceleration would suggest lack of pituitary stimulus, which may be correlated with the latter's basophil reaction; whilst the pituitary given in pituitary treatment might overcome any thyroid influence and induce greater activity in the gland and hence an oxyphil reaction.

Another significant observation is the fact that the pituitaries appeared to be more or less normal (that is, like the controls) in acceleration produced by iodine treatment, whilst the thyroids resembled those in acceleration under thyroid influence. The affinity of the thyroid for iodine is well known. On the other hand, no such affinity exists between iodine and the pituitary, and, further, apparently only thyroid can utilize iodine in metamorphosis (Spaul, 1925). Hence acceleration here would appear to be produced by the accelerating agent alone without any great assistance, so far as can be ascertained from histology, from the glands themselves. This action, therefore, would also be more or less direct. The direct action of the thyroid on the tissues in producing metamorphosis has already been commented on by various workers (Uhlenhuth and Schwartzbach, 1927; Spaul, 1925, 1930), and evidence has already been put forward suggesting a similar action in the case of the pituitary (Spaul, 1930), which would appear to gain some support from these observations.

As regards the action of the posterior lobe, not only is metamorphosis inhibited, but the thyroid and pituitary remain similar to controls at the same stage.

Allen (1929), working on the histogenesis of the anterior pituitary in *Bufo* during metamorphosis, described a consistent increase in the number of eosinophil cells during the process, together with a sudden increase in the number of basophil cells during the latter part of the change, from which he suggested that "the fact that the basophil cells first undergo rapid increase at the crucial point seems to indicate their significance in connection with the problem of metamorphosis." In the case of *R. temporaria*, however, no such increase in the number of the basophil and oxyphil cells has been observed, which further impresses the need for a complete survey before any deductions can be drawn.

V.—Summary.

1. Oxyphil, basophil, and neutrophil cells of similar structure are present in the anterior pituitary of the tadpole. Their proportions and structure remain approximately the same as metamorphosis proceeds, nor do they alter under the influence of accelerating agents such as thyroid, pituitary, and iodine. These cells have large nuclei with a small amount of granular cytoplasm, and can be only satisfactorily distinguished by their staining reaction.

The posterior lobe consists of basophil cells which remain unaffected in metamorphosis whether normal or accelerated.

2. In acceleration produced by injections of the anterior pituitary, the thyroid passes through approximately the same sequence of changes as controls metamorphosing at the normal rate, whilst the pituitary shows a distinct reaction marked by the increased oxyphil affinity of the cytoplasm of the cells.

3. In acceleration produced by the thyroid, the thyroid remains undeveloped and the cytoplasm of the pituitary cells shows a distinct basophil affinity, the reverse reaction from that found in acceleration produced by anterior pituitary injections.

4. The different responses of the pituitary are emphasized by the response to the iodine cyanosin technique, which is most intense in acceleration produced by the anterior pituitary and least when thyroid is administered.

5. If oxyphility indicates increased and basophilicity reduced activity of the pituitary, it is possible that the anterior pituitary can stimulate both the thyroid and pituitary glands as well as metamorphosis, while the thyroid stimulates the tissues only to produce metamorphosis.

6. The pituitaries appear normal in acceleration produced by iodine, but the thyroids resemble those to which thyroid has been administered.

7. The thyroids and pituitaries of animals treated with extract of posterior lobe pituitary are similar to those of controls at the same stage.

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DESCRIPTION OF PLATES.

PLATE I.

Transverse sections of thyroid glands of tadpoles immediately before metamorphosis. The fore-limbs are still beneath the operculum, hind-limbs developed, degree of tail absorption varies with treatment.

- A. *After Injection of Thyroid Extract.*—The section shows cubical and flattened vesicular epithelial cells, and shrinkage and vacuolation of the colloid masses.
- B. *Control.*—The section shows the cubical and columnar cells of the vesicles, which are packed with colloid. Large droplets staining similarly to the colloid are seen in the distal part of many of the cells.
- C. *After Injection of Anterior Pituitary Extract.*—The section shows the varying nature of the vesicular epithelium, and of the density and vacuolation of the colloid. Colloid is absent from one vesicle. A group of undifferentiated epithelial cells is seen in the centre of the gland.
- D. *After Treatment with Iodine Solution.*—The section shows the tendency of the vesicular epithelial cells to be flattened, and the variation in density of the colloid.
- b, red blood corpuscle.
c, connective tissue.
e, undifferentiated epithelium.

PLATE II.

Median sagittal sections of pituitary glands of tadpoles immediately before metamorphosis. The sections were stained by using the iodine technique (Spaul and Howes, 1930), the degree of oxyphilia being indicated by the depth of staining as shown in the plates.

- E. *After Injection of Thyroid Extract.*—The pituitary cells have slight affinity for acid stains. There is a group of acidophil cells in the centre of the anterior lobe of the gland.
- F. *Control.*—The cells are intermediate in staining reaction between those of animals treated with thyroid and pituitary extracts.
- G. *After Injection of Anterior Pituitary Extract.*—The pituitary appears much darker, showing the increased affinity of the cells for acid dyes, and the distribution of these cells over the entire gland.

ABSTRACTS AND REVIEWS.

ZOOLOGY.

(Under the direction of G. M. FINDLAY, M.D.)

HISTOLOGICAL TECHNIQUE AND STAINING.

A New Fixative.—D. C. CARPENTER and B. R. NEBEL ("Ruthenium Tetroxide as a Fixative in Cytology," *Science*, 1931, 74, 154-5). Ruthenium tetroxide is in certain respects a better fixative than osmium tetroxide. It is said to be of value for demonstrating the chromonematic structure of chromosomes, but unfortunately it decomposes very readily. To reduce the amount of decomposition chlorine water may be used as a solvent. An ampoule containing 1 gm. is broken in 100 c.c. of saturated chlorine water and for use is diluted 1 in 20 either with distilled water, 0.25-1 p.c. formic or acetic acid. The fixative is applied for 3 minutes. G. M. F.

Ultra-violet Light and the Ripening of Hæmatoxylin.—E. J. KOHL and C. M. JAMES ("A Method for Ripening Hæmatoxylin Solutions Rapidly," *Science*, 1931, 74, 247). Very vigorous hæmatoxylin solutions may be obtained by exposure to the quartz mercury vapour lamp. The solutions, which must be stirred frequently, are placed in wide shallow evaporating basins at a distance from the source of light of about 2 feet. Ehrlich's and Delafield's hæmatoxylin solutions require an exposure of from 2-4 hours, Heidenhain's hæmatoxylin somewhat less. G. M. F.

A Rapid Method of obtaining Paraffin Sections.—P. W. BOWMAN and M. N. LINCH ("A Short Method for the Preparation of Animal Tissues for Staining," *Science*, 1931, 74, 440). Tissues are cut in pieces of from 2-4 mm. in thickness, placed in 10 p.c. formalin and heated to the boiling-point. They are then transferred to acetone and left there for 1 hour, during which time the acetone should be poured off and renewed two or three times. It is best to cover the dish and place it in the paraffin oven, as at higher temperatures diffusion is more rapid. After removal from the acetone the tissue is placed in melted paraffin and left in the oven for an hour. Sections are cut in the usual manner. G. M. F.

A Method for Preventing the Curling of Microtome Sections.—E. A. VARRELMAN ("Paper Apron to Prevent Curling of Microtome Sections," *Science*, 1931, 74, 20). A piece of wet tissue paper, preferably dark coloured, narrower than the knifeward edge of the block and longer, is placed on the paraffin block. The cut section, with the paper, rests flat on the knife with the overlapped edge in such position that the paper, with section adhering, can be removed with forceps or scalped and placed on a wet slide where the section can be orientated and the paper removed leaving the section in place. The process works better with a sliding than with a rotary microtome. G. M. F.

A Modification of the Gram-Weigert Stain.—H. M. WALLACE ("A Stain for Fibrin, Gram-positive Bacteria, and Basal Bodies in Tissues," *Science*, 1931, 74, 369-70). Tissues are fixed in Zenker's fluid or formol Zenker and are stained lightly in hæmatoxylin and washed; 0.5 p.c. aqueous eosin (Grübler's water soluble) is applied for 30 seconds and washed. Sections are then stained for 2 hours in Weigert's aniline methyl violet, prepared as follows: Solution 1, absolute alcohol 33 c.c., aniline oil 9 c.c., methyl violet in excess; Solution 2, saturated aqueous solution of methyl violet (Grübler's 6B₁ only); 1 part of solution 1 is mixed with 9 parts of solution 2 not more than 10 days before use. It acts best when from 3-8 days old. After washing and transference to Lugol's solution for from 10-15 minutes, sections are again washed, blotted with filter paper, and differentiated in a mixture of 1 part of aniline oil and 2 parts of xylol: cleared in two changes of xylol and mounted. Gram-positive bacteria, fibrin and ciliary basal bodies are stained a deep purple, nuclei a dark blue, blood corpuscles usually pale blue or at times pink. G. M. F.

A Silver or Gold Impregnation Method for Protozoa.—J. VON GELEI and P. HORVATH ("Ein nasse Silber-bzw. Goldmethode für die Herstellung der reizleitenden Elemente bei den Ciliaten," *Ztschr. f. Wiss. Mikr.*, 1931, 48, 9-29). By this technique subpellicular, conductive, and other elements in protozoa are brought out. The procedure is as follows: Fix in fresh formol sublimate (5 c.c. formalin to 95 c.c. of concentrated HgCl₂) 1-3 minutes. Centrifuge and wash in two changes of tap water. Place in a silver bath (1-2 p.c. AgNO₃) for 2-30 minutes. Centrifuge and reduce in direct sunlight, in distilled water, or if staining of the cilia is desired, in tap water, or equal parts of 1 in 10 formol and 1 in 10 ammonia may be used. Wash in several changes of distilled water. Pass through alcohols and mount in glycerine alcohol or through xylol to xylol balsam. If gold impregnation is desired this is introduced after washing in several changes of distilled water. For the gold bath 3 c.c. of distilled water with 1 drop of 1 p.c. gold chloride is employed. Material is left for one to several hours. Agitation of the tubes with every new fluid is recommended and pouring off the fluid after centrifuging, instead of pipetting. The method is not as permanent as Klein's, for the stain fades out easily. G. M. F.

A New Celloidin-Paraffin Method for Sections.—J. H. C. RUYTER ("Eine einfache Methode für das Aufkleben von Zelloidin-Paraffinschnitten," *Ztschr. f. Wiss. Mikr.*, 1931, 48, 226-7). The original celloidin-paraffin method of Apathy has been improved by various workers. An acetone-methyl-benzoate medium, instead of water, is suggested for spreading sections on the slides as the celloidin is softened without being absolutely dissolved. The mixture is prepared by adding 1 drop of methyl benzoate to 2 c.c. of acetone and then to 8 c.c. of distilled water. Add 2-3 drops of albumen-glycerine if desired. Mount as in the usual paraffin-water procedure but use less heat, as the sections begin to straighten even before any heat is applied. G. M. F.

Thermal Relations in the Neutral Red Reaction.—V. KOEHRING (*Journ. Morph. & Phys.*, 1931, 52, 165-94). Neutral red staining, as observed in plant and animal material, closely approximates in its reactions to temperature the reactions of enzyme to the same factor. G. M. F.

A New Technique for Mitochondria.—P. KRUSZYNSKI ("Une nouvelle methode pour la detection du chondriome," *Bull. d'Histol. appl.*, 1931, 8, 207-9).

The following method, based on the property of chromic salts to transform lipins into insoluble compounds, is an application of Cajal's uranium nitrate technique. Fix for from 10-24 hours in Cajal's solution—uranium nitrate 1 part, neutral formalin 15 parts, distilled water 85 parts. Rinse rapidly in distilled water. Treat with 3 p.c. aqueous potassium bichromate for from 1-3 days: wash, pass through the alcohols, and embed in paraffin. Stain with Heidenhain's hæmatoxylin or Altmann's basic fuchsin.

G. M. F.

Acetone as a Substitute for Alcohol.—J. E. SASS ("Acetone as a Substitute for Alcohol in Microtechnic," *Stain Technol.*, 1932, 7, 65-6). Dehydration takes place in 15, 20, 25, 30, 35 p.c., etc., through two changes of anhydrous acetone at 15-minute intervals. Sections are cleared in four grades of acetone xylol.

G. M. F.

Modifications of Differential Stains.—R. CASTROVIEJO ("Modifications of Differential Stains with Special Reference to the Trichromic Stain of Cajal," *Amer. Journ. Clin. Path.*, 1932, 2, 135-40). Modifications of the trichromic stain of Cajal are described and discussed. The original technique was difficult owing to the fact that alcohol acted as both a differentiating and dehydrating fluid at the same time. Calleja used borax or lithium carmine instead of basic fuchsin, but Gallego's modification is probably more satisfactory. Fix tissues in 10 p.c. formaldehyde (sections may be cut by the freezing method or after embedding in paraffin or celloidin). Stain 1 minute in Ziehl's acetic fuchsin (Ziehl's fuchsin 10 drops, acetic acid 1 drop, distilled water 10 c.c.). Wash in water. Differentiate and "viro-fix" in formalin-acetic solution for 5 minutes (formalin 2 drops, glacial acetic acid 2 drops, distilled water 10 c.c.). Wash in water. Picro-indigocarmine 1 minute (aqueous solution of indigocarmine 1 p.c., 1 part and aqueous saturated picric acid 2 parts). Wash in water, alcohols, xylol, and mount. Nuclei stain red-violet, cartilage, mucin, and mast cells bluish-violet, cytoplasm clear green or yellowish-green, connective tissue an intense blue, muscle fibres a clear green. This stain may be combined with the van Gieson technique by staining for 1 minute with van Gieson's picrofuchsin in place of picro-indigocarmine; 1 p.c. aqueous eosin for 30 seconds instead of the picro-fuchsin also gives beautiful results. The author finds that the Ziehl's acetic fuchsin is better when the following formula is used: Ziehl's fuchsin 15-20 drops, 2 drops formaldehyde, and 2 drops of acetic acid for each 10 c.c. of water.

G. M. F.

The Histological Demonstration of Gold.—P. GAUTHIER-VILLARS ("Recherche histochemique de l'or," *Compt. rend. Soc. de Biol.*, 1932, 109, 197-8). Two methods have been employed: (1) Reduction by stannous chloride (SnCl_2). Material is fixed in Bouin and passed into paraffin. After cutting the sections should be dried for about a week to ensure their firm adherence to the slides. After passing down to water sections are placed in a 5 p.c. solution of stannous chloride in distilled water to which enough hydrochloric acid has been added to cause disappearance of the opalescence. Sections are placed in an oven at 56° C. for 24 hours, then washed with care, stained with eosin, and mounted in balsam. (2) Reduction by light. Sections are passed down to distilled water and then placed under an ultra-violet light for 12 hours. The reduction obtained is less complete than with stannous chloride.

G. M. F.

A Simple and Selective Technique for the Impregnation of Microglia.—J. M. ROMERO MARTINEZ ("Noticia de una técnica fácil y muy selectiva para la

impregnación de la microglia," *Bol. de la Soc. españ. de Hist. nat.*, 1931, **31**, 653-8, 2 text-figs.). The following simple technique for the impregnation of microglia is described: Portions of brain or cord tissue are fixed in formal bromide (ammonium bromide 10 parts, formalin 70 parts, water 430 parts) for 1 hour at 55° C., or for from 1 day to 3 months at ordinary temperature. The best results were after fixation for from 2-5 days. Before fixation the tissues were heated for 20 minutes at 50° C. Sections were cut by the freezing microtome and washed in ammoniacal water for 5 minutes (water 50 c.c., ammonia 10 drops), then washed rapidly in distilled water; impregnated for 15 minutes at room temperature in the following solution:

Silver nitrate, 10 p.c.	50 c.c.
Sodium tungstate, 2 p.c.	50 c.c.
Ammonia in sufficient quantity to dissolve the silver tungstate.	

The sections acquire a faint yellow tint most marked in the white matter. Sections are washed in distilled water and reduced in neutral 10 p.c. formalin until the sections are uniformly faint yellow. Wash in distilled water and place sections in a solution of gold chloride, 0.2 p.c., for 5 minutes in the cold and then for from 10-15 minutes at 45-50° C. till the sections are uniformly black. Fix the sections in sodium hyposulphite 5 p.c. solution when they acquire a clear purple tint. Wash in water, pass through the alcohols, clear in creosoted carbol xylol, xylol, and mount in Canada balsam. The microglia cells stand out very distinctly. Quite good results may be obtained after fixation in 10 p.c. formalin or even Kaiserling's fluid.

G. M. F.

A Rapid Method for Frozen Sections.—A. C. BRODERS ("Modification of Wilson's Fresh Frozen Section Technic," *Journ. Lab. & Clin. Med.*, 1931, **16**, 734-8). Slides are ready for examination in 50 seconds and tap water is used in place of the dextrine, physiological salt solution, and glucose. Slices of tissue, 2-10 mm. in diameter, are cut, dipped in water, and arranged on the freezing microtome which is turned on in intermittent spurts until about half the tissue is frozen. Sections are cut about 15 μ thick and floated in a glass dish. They are then transferred to Terry's polychrome methylene blue. Transfer to tap water, lift once or twice and allow them to float till the excess stain washes out. Mount in water.

G. M. F.

A Modification of Ramon y Cajal's Silver Impregnation Method for the Peripheral Nervous System.—B. A. FAVORSKY ("Eine modifikation des Silberimpregnationsverfahrens Ramon y Cajals für das periphere Nervensystem," *Anat. Anz.*, 1930, **70**, 376-8). Tissues are placed for 24 hours in 0.5-5 p.c. acetic acid in 50, 60, or 80 p.c. alcohols. For tough tissues use lower percentages of alcohol (50 p.c.) and more of the acetic (3-5 p.c.) and reverse for soft material. Wash in 50 p.c. alcohol for several hours, then transfer to ammoniacal alcohol (96 p.c. alcohol 10 parts, ammonia 1 part) for 2 days. Wash in several changes of distilled water till the objects sink. Transfer to pyridine for 1-2 days. Keep in running water for from 12-24 hours and then through several changes of distilled water. Treat with 2 p.c. silver nitrate at 37-38° C. for from 4-10 days. Rinse in distilled water and reduce for 24 hours in pyrogallol acid 1 part, neutral formalin 10 parts, distilled water 100 parts. Dehydrate in alcohols (do not leave for more than 1½ hours in 70 p.c. alcohol) and embed in paraffin. The axones of the peripheral nerve fibres, neurofibrils, ganglion cells, the termination of nerves in muscles and epithelia are all well impregnated and show less shrinkage than with the usual methods.

G. M. F.

"Nucplascoll," a New Stain for Histological and Botanical Sections.—H. GEIDIES ("Nucplascoll, ein neuer Farbstoff für histologische und botanische Schnittfärbungen," *Mikr. f. Naturfreunde*, 1928, 6, 378–80). "Nucplascoll" is a modified iron hæmatoxylin stain with metachromatic qualities prepared by Grübler's laboratory in Leipzig. It is allowed to act for 30–40 minutes; sections are rinsed in water, passed through 96 p.c. alcohol, dehydrated, and mounted in Canada balsam. Muscle reddish with dark nuclei; nuclei of the stratum granulosum and basal layer of the epidermis purplish; connective tissue green; blood corpuscles light red; gland colloid transparently pink; cartilage bluish-violet. The dry product should be kept well corked and away from sunlight. G. M. F.

A Modification of the Mallory-Heidenhain Differential Staining Method.—J. W. KERNOHAN ("A New Modification of Mallory-Heidenhain's Differential Staining Method and Adaptation of Formalin-Fixed Material for Mallory's Stains," *Amer. Journ. Clin. Path.*, 1931, 1, 399–403). The following technique allows Mallory's differential stains to be used on material fixed in 10 p.c. formalin. Wash tissue in ammonia water, then place for 4 days in Weigert's primary mordant for myelin sheaths (potassium bichromate 5 gm., chromium fluoride 2 gm., water 100 c.c.) and for 2 days in Weigert's secondary mordant for myelin sheaths (copper acetate 5 gm., chromium fluoride 2.5 gm., acetic acid 36 p.c. 5 c.c., water 100 c.c., formalin 10 c.c.). Stain paraffin sections with Mallory's phosphotungstic acid hæmatoxylin. G. M. F.

A Method for the Demonstration of Calcium and Tubercle Bacilli in the Same Sections.—L. YUAN-PO ("Méthode pour mettre en évidence, sur la même coupe, les bacilles tuberculeux et le calcium," *Compt. rend. Soc. de Biol.*, 1931, 106, 648–9). Stain with hæmalum for from 2–5 minutes; wash in tap water for at least 10 minutes. Stain in Ziehl Neelsen fuchsin for 20 minutes without heat. Differentiate in a saturated solution of sodium bicarbonate in 70 p.c. alcohol for from 30–60 minutes. Wash and counterstain with 5 p.c. Kühne's blue for 5 minutes. Differentiate in alcohol with some oil of cloves for from 5–10 minutes. Dehydrate, pass through xylol and mount. Bacteria are red, calcium bluish-violet, tissue greyish-blue. G. M. F.

An "Intravital" Technique for the Study of the Grasshopper.—W. J. BAUMGARTNER and M. A. PAYNE ("Intravital" Technic used in Studies on the Living Cells of Grasshoppers," *Journ. Exp. Zool.*, 1931, 59, 359–93). By means of this method cellular structures and inclusions are seen in the living cell, connected with the organism, so that its normal metabolism remains unaltered. A male grasshopper is anesthetized for several seconds and its hind legs are severed at the autonomous joints. The wings are cut off behind the pronotum and a rectangular opening is cut through the chitinous wall of the second, third, and fourth segment, just left of the mid dorsal line. The insect is then placed on its right side on a slide, parallel to its width. Melted paraffin is run from a pipette over the forelegs and antennæ, around the head, and along the ventral side of the body which faces the right-hand side of the slide. A narrow ribbon of paraffin is led up and back to the anterior end of the insect. Spiracles on the abdominal wall and the anal aperture are left open. The paraffin walls, together with the body and the enclosed surface of the slide, form a small basin, which is filled with Belar's fluid, which is isotonic with the germ cells. Before the grasshopper recovers, the testes are drawn out of the abdominal aperture. The yellowish membrane, which encloses the follicles, is carefully torn away and the latter float out in the basin, remaining attached to the vasa efferentia. Several follicles are secured with a

loop of silk thread and the latter is attached to paraffin. This facilitates observation of the living cells and allows the study of movements. Most of the details of spermatogenesis described in fixed tissues have been seen in living cells through cyst and follicular walls, while chromosomes are observed to move and divide.

G. M. F.

Rapid Methods for Colouring Negri Bodies.—G. PETRAGNINI ("Metodi rapidi di colorazione dei corpi del Negri," *Boll. Inst. Sierò Milanese*, 1928, 7, 557-61). The following mordant is prepared: Dissolve ground potassium alum. 3 gm., lead acetate 0.5 gm., 3 drops of acetate acid in 100 c.c. of water; mix with tannic acid 7 gm., ferric chloride 2 gm., methyl alcohol 35 c.c., and 15 c.c. of water. Filter after 2 or 3 days and dilute with 20-50 or more volumes of methyl alcohol. *Method I*: Pass paraffin sections through xylol and absolute alcohol. Treat 5-10 seconds with dilute mordant; wash rapidly in absolute and 95 p.c. alcohol. Stain for from 10-20 seconds in 0.5 p.c. eosin in 50 p.c. alcohol, and wash slowly in water. Stain 1 minute in Mayer's hæmatoxylin, wash rapidly; stain with methylene blue until violet, dry with filter paper; agitate in 0.25 p.c. N/2 NaOH for 15-20 seconds; wash with 90-95 p.c. alcohol till a general blue, absolute alcohol, xylol, and neutral balsam. Results—nerve cells blue; nuclei, capillaries, and endothelia brilliant red; nucleoli dark blue; Negri bodies eosin red. *Method II*: Treat with mordant diluted 100-200 volumes of water; wash with absolute, then 75 p.c. alcohol; stain with eosin as above, or acid fuchsin, wash; alcohols, xylol, and mount. Cell bodies pink, Negri bodies red. *Method III*: Treat with mordant 1 volume in 20-40 volumes of methyl alcohol for from 5-10 seconds, then acid fuchsin 1 minute; wash; stain with 0.2 p.c. indigocarmine for 5-20 seconds; wash, then 95 p.c. absolute alcohol, xylol, and balsam.

G. M. F.

A New Method of Differentiating Gentian Violet.—D. A. JOHANSEN ("A New Method of Differentiating Gentian Violet when used as a Somatic Chromosome Stain," *Stain Technol.*, 1932, 7, 17-20). The addition of 0.5 p.c. picric acid crystals to the dehydrating alcohols makes possible a much better differentiation of gentian violet than has previously been obtainable. The final differentiation should be carried out with pure clove oil. Two or three trials should reveal the optimum time.

G. M. F.

A New Dehydrating Agent.—O. C. BRADBURY ("A New Dehydrating Agent for Histological Technique," *Science*, 1931, 74, 225). Ethyl alcohol can be replaced by iso-propyl alcohol in the dehydration of animal tissues and has much less hardening effect. Iso-propyl alcohol is obtained 98-99 p.c. pure. G. M. F.

The Demonstration of Urates in Sections.—A. C. HOLLANDE ("L'insolubilisation des urates figurés dans les coupes histologiques," *Bull. d'Histol. appl.*, 1931, 8, 176-8). This is a modification of Courmon-André's method. Tissues are fixed in equal parts of 1 p.c. silver nitrate and 4.4 p.c. formalin (the latter may be neutralized with calcium carbonate) for from 12-24 hours, in darkness. Wash in distilled water for 24 hours, changing it several times. Dehydrate in 75, 90, 95, and 100 p.c. alcohol and embed. Sections are stained, if desired, in hæmalum for 10 minutes; wash several hours under tap water; apply 1 p.c. aqueous orange G or eosin, as preferred, for 30-60 minutes; rinse in distilled water. Transfer to 0.5 p.c. phosphomolybdic acid, rinse in water and stain in 0.12 p.c. aqueous light green for 1-10 minutes. Differentiate rapidly in 96 p.c. alcohol. Dehydrate with iso-amyl-alcohol, pass through xylol and mount in balsam. Excellent results were thus obtained with adipose tissue surrounding the urate-containing cells and

bacteriocytes of *Periplaneta orientalis* L. Urates appear black, chromatin blue, protoplasmic inclusions red or orange, depending on the counterstain; collagen and products of secretion light green. G. M. F.

Silver Impregnation of Connective Tissue in Histological Preparations previously Stained by Other Methods.—I. DEL CARPIO ("Impregnazione argenta del tessuto reticolato in preparati istologici precedentemente colorati con altri metodi," *Diagnostica e tecnica di lab.*, 1930, 2, 1030-33). This method may be used for sections previously stained with hæmatoxylin and eosin, Mallory's method, or Cajal-Gallego's technique. Sections are passed down to water and remain in distilled water for from a few minutes to some hours in order to obtain a partial decolorization. They are then transferred for from 15-20 minutes in an 0.25 p.c. solution of potassium permanganate; wash in distilled water for a few seconds and then immerse in a 5 p.c. aqueous solution of oxalic acid. Wash for 1 minute in distilled water, with three changes, then place for 24 hours in a 2 p.c. aqueous solution of silver nitrate. Wash in water for 1 minute, with two changes, then place for 30 minutes in ammoniacal silver nitrate solution. (Silver nitrate 1 gm. dissolved in 10 c.c. of distilled water to which are added 11 drops of a 40 p.c. aqueous solution of sodium or potassium hydroxide; the resulting precipitate is dissolved by the addition of 20 p.c. ammonia, drop by drop, and the solution made up to 100 c.c. with distilled water.) Wash in two changes of distilled water for some seconds, then 15 seconds in neutral 4 p.c. formalin. Wash in tap water for 1 minute, then place in 2 p.c. gold chloride till a grey colour is obtained; wash for 1 minute in tap water, then 5-10 minutes in 5 p.c. sodium thiosulphate. Wash in tap water, ascending alcohols, xylol, and mount in Canada balsam.

G. M. F.

A Method of Silver Impregnation.—N. C. Foot and E. B. Foot ("A Technique of Silver Impregnation for General Laboratory Purposes," *Amer. Journ. Path.*, 1932, 8, 245-54, 1 pl.). Silver impregnation can be applied for ordinary histological examinations. The finest results were obtained after fixation in 10 p.c. formalin for 24 hours at least, or in Zenker's fluid for 24 hours. After embedding and cutting, the sections are passed through two changes of xylol and absolute alcohol and are then treated for from 1-24 hours with a mixture of 2 parts pure pyridine to 1 part of pure glycerol. From this bath sections are transferred directly to two changes of 95 p.c. alcohol, washed in tap water, and placed in distilled water. As impregnating fluid there is used either a simple silver diammino hydroxide solution or a silver diammino carbonate. The former is prepared as follows: To 10 c.c. of 10.2 p.c. silver nitrate solution in distilled water, strong ammonia is added drop by drop till the brown precipitate is redissolved. 10 c.c. of 3.2 p.c. pure sodium hydroxide solution in distilled water is added and the reprecipitated silver hydroxide again just dissolved by the addition of a few more drops of ammonia. The solution is then made up to 100 c.c. with distilled water that has been heated to about 50° C. Silver diammino carbonate is prepared by adding ammonia drop by drop to the silver nitrate solution as before, and then 10 c.c. of 3.1 p.c. sodium carbonate in distilled water in place of the hydroxide. Sections are impregnated in the solutions in a closed staining box in the incubator at 37° C. for 1 hour. The developer is a mixture of strong neutral formalin (40 p.c. formaldehyde) 1 c.c., 1 p.c. sodium carbonate in distilled water 3 c.c., and distilled water to make 100 c.c. Three minutes complete reduction. The toning bath is a 1 in 500 solution of Merck's "acid brown" gold chloride in distilled water. The fixing fluid is the usual 5 p.c. sodium thiosulphate. The variants may be sum-

marized as follows: (1) Neutral formalin or Zenker fixation; (2) paraffin embedding; (3) pyridine-glycerol pretreatment for from 1-24 hours; (4) in variants 4, 5, and 6, tannic acid mordant for 15 minutes, followed by "stop" solution of ammonia for 30 seconds. The tannic acid mordant is made up of pure tannic acid 0.2 gm., ammonium bromide 3.5 gm., strong neutral formalin 5 c.c., distilled water to 500 c.c. The stop solution consists of 100 c.c. distilled water to which has been added 3-5 drops of strong ammonia. (5) Variants 1, 2, and 3: impregnation in warm silver diammino hydroxide for 1 hour; variants 4, 5, and 6: impregnation in this bath at half strength for 10 minutes. (6) Reduction in formalin-soda developer for 3 minutes. (7) Toning in 1:500 gold chloride for 3 minutes in variants 1 and 4; other variants 10 minutes. (8) Reduction of gold in variants 2 and 5 with 5 p.c. oxalic acid; variants 3 and 6 with formalin-soda, in either case for 10 minutes. (9) Fix in 5 p.c. sodium thiosulphate in variants 1 and 4 for 3 minutes, other variants for 10 minutes. Thorough washes are indicated between all steps, distilled water being required till the sections have been reduced in step 6, after which tap water is employed throughout.

G. M. F.

Cytology.

Histo-physiological Studies on the Spleen in Tissue Cultures.—A. LLOMBART ("Estudios histo-fisiologicos sobre el bazo en los cultivos de tejidos," *Bol. de la Soc. españ. de Hist. nat.*, 1931, 31, 581-610, 8 pl.). Tissue cultures were made of the spleens of newly born rats in a mixture of four parts of rat plasma and one of extract, made either from rat bone marrow, rat spleen, a commercial extract of spleen "splenotrat," chick embryo, or Flexner-Jobling carcinoma. Connective tissue elements, endothelial cells, and blood cells were all produced. By transformation of the connective tissue cells, monocytes or endothelial cells, there arise macrophages, principally when the medium is fluid. The macrophages are a cellular type with definite histological characteristics specialized for phagocytosis and exhibiting a definite cycle, a period of great activity, followed by degeneration and death. Cultures made with different extracts showed a preponderance of one type of cell—abundance of macrophages with extract of bone marrow, hypertrophy and rapid growth of fibroblasts with spleen extract, increase in the endothelial cells and eosinophils with Flexner-Jobling carcinoma.

G. M. F.

Cultivation of Chick Fibroblasts in the Plasma of Hens with the Rous Sarcoma.—J. ZWEIBAUM and M. OSTROUCH ("Recherches sur l'action du plasma d'animaux sarcomateux sur les fibroblastes du poulet, cultivés *in vitro*," *Bull. internat. de l'Acad. polonaise des Sci. et des Lettres (Classe de Méd.)*, 1931, 3, 53-60). The plasma from hens bearing the Rous sarcoma has a toxic action on chick embryo fibroblasts cultured *in vitro*. The cultures grow more slowly and after a certain number of passages cease to grow. The fibroblasts show a greater clarity of their cytoplasm and the fat granules disappear entirely, while the outline of the cells becomes difficult to distinguish.

G. M. F.

Vital Staining of the Rabbit's Aorta.—G. L. DUFF ("Vital Staining of the Rabbit's Aorta in the Study of Arteriosclerosis," *Amer. Journ. Path.*, 1932, 8, 219-34). In rabbits intravenous injection of a suitable quantity of a solution of trypan blue results in well marked staining of the wall of the aorta within 16 hours. Variations in depth of colour are seen on the intimal surface of the aorta as the

result of irregularities in the staining of its outer layers. The deeply stained areas correspond to the areas in which the aortic wall is most plentifully supplied by vasa vasorum. The staining of the wall of the aorta is chiefly due to the escape of the dye through the capillary endothelium, which is much more permeable to trypan blue than is the lining endothelium of the aorta. The local variations in depth of staining in the aorta are thus dependent on the degree of vascularization of its wall. The production of an inflammatory reaction in the external layers of the aorta brings a local increase in capillary permeability to trypan blue and as a result a stronger staining of the vessel wall in the inflamed area.

G. M. F.

The Distribution of Calcium and Magnesium in the Normal and Pathological Aorta as Demonstrated by a Spectrographic Method.—A. POLICARD, A. MOREL, and P. P. RAVAUULT ("Étude histospectrographique de la localisation du calcium et du magnésium dans l'aorte humaine et de leurs variations au cours de l'athérome," *Compt. rend. de l'Acad. des Sci.*, 1932, **194**, 201-4). The intima of the normal aorta contains more calcium than magnesium, while the media contains more calcium and proportionately much more magnesium than the intima. In the intima affected with lipoid degeneration the calcium but not the magnesium is increased, while in the media both substances are diminished, the latter in far greater proportion. In the calcified patches there is a very great increase in calcium but not in magnesium.

G. M. F.

Histology.

Seasonal Changes in the Kidney of the Frog.—CHI LAN TSUI (*Contrib. Biol. Lab. Sci. Soc. China*, 1931, **7**, 239-47, 12 text-figs.). A study of the kidneys of frogs, *Rana nigromaculata*, collected at various times of the year near Nanking, revealed definite seasonal differences. During summer there was abundance of secreted material in the proximal convoluted tubules as well as in Bowman's capsule. This latter waste material is apparently filtered through the capillaries of the glomerulus. In winter, when metabolic activities are at a minimum during hibernation, the process of secretion is very slow, the glomeruli become contracted, and the proximal convoluted tubules remain inactive.

G. M. F.

Splenectomy and Cholesterol.—C. I. PARHON, A. BLINOV, and M. CAHANE ("Sur la teneur en cholestérol du sang et des surrénales chez les cobayes splénectomisés," *Compt. rend. Soc. de Biol.*, 1932, **109**, 239-40). Removal of the spleen in guinea-pigs produces a hypercholesteræmia which persists for some months. For the first two months after the operation there is an increased cholesterol content of the suprarenals.

G. M. F.

Histological Changes in the Parathyroids.—C. I. PARHON and M. BRIESE ("Recherches sur les variations structurales des parathyroïdes en rapport avec les différentes conditions physiologiques ou expérimentales," *Compt. rend. Soc. de Biol.*, 1932, **109**, 241-2). Cells poor in cytoplasm are common in winter, rare in summer. Cells poor in cytoplasm are also found during pregnancy and in animals treated with excessive thyroid secretion. During lactation there are many cells rich in protoplasm. The foetal parathyroid begins to function as soon as bone is laid down in the primitive cartilage.

G. M. F.

Mollusca.

Acmaea funiculata (Carpenter) at Monterey Bay.—G. D. HANNA and A. G. SMITH (*Nautilus*, 1931, 45, 21-5, 1 pl.). This seldom-noticed limpet was discovered recently by dredging in the original locality by the authors of the paper, who also received specimens from Mr. George Willett. The radula is shown, but further elucidation of this structure would be of interest; the two figures given are probably quite old, and we are unable to determine which is the more authentic. Though the radulae of limpets were examined with considerable care by S. P. Woodward and other microscopists of the last century, it can hardly be said that their structure is yet understood. A careful study of *Patella* and *Acmaea* would be of much interest. The authors have collected the few facts known about this *Acmaea* with much care.

E. W. B.

A Jamaican Fluvatile Nerita.—H. A. PILSBRY (*Proc. Ac. Nat. Sci. Phil.*, 1932, 84, 11-13, 2 figs.), makes a new sub-genus of *Nerita* (*Fluvinerita*) to accommodate this form, which is regarded as a *Nerita* in consequence of Mr. Baker's study of the radulae in 1923. This brings us to the suggestion that this *Theodoxus*-like shell has been separately evolved from *Nerita* in this particular locality. The hypothesis is interesting, but it would be easier to imagine that the curious opercular rib and pit was a modification of the usual peg apparatus. The paper will, however, have value if it draws attention to the need for further information about the origin of the "peg."

E. W. B.

The Genus Polygyrella.—H. A. PILSBRY (*Proc. Ac. Nat. Sci. Phil.*, 1932, 84, 15-19, 8 figs.). "Binney's description and figures are at fault in every point of importance." It is fair to add that the new information received about this species or family renders it increasingly doubtful how far the term *Odontognatha* can be usefully retained in classification. Like all moderately ancient characters the "toothed jaw" tends to be found in considerable groups of full-grown forms, but it is unnecessary to conclude that all such forms are closely related. It is also unnecessary to censure Binney for not having understood, fifty or sixty years ago, the true meaning of those elaborations of the snail's genitalia which have never yet been studied histologically.

E. W. B.

The Structure of the Heart in *Murex trunculus*.—G. MORIN and A. JULLIEN ("Sur la structure du cœur chez *Murex trunculus*," *Bull. Hist. Appl. Phys. et Path.*, 1930, 7, 79-96, 4 text-figs.). The muscular system of the heart is composed of circular and longitudinal fibres, both striate, the latter serving as a conductor system from very primitive muscle at the ventricular base. Nerve cells are present. The striations are confined to the middle of the cells and longitudinal fibrils are prominent.

G. M. F.

***Natica* as a Radicle.**—A. L. MATHEWS (*Amer. Nat.*, 1930, 64, 430-35). Observations of fossil and living coiled gastropods show that the protoconchs are naticoid. *Natica* is the radicle for the entire group, as it is said to fulfil the following biogenetic law: If any primitive character appears in the protoconchs of the highly divergent stocks which can be attributed to the simple early form, it would indicate that such a form serves as a parent form for the divergent stocks and can thus be regarded as the radicle for the entire group.

G. M. F.

Arthropoda.

Insecta.

New Reduviidæ.—M. D. HAVILAND (Mrs. H. H. BRINDLEY) ("The Reduviidæ of Kartabo, Bartica District, British Guiana," *Zoologica*, vii, No. 5, 1931, 129-54, 2 text-figs.). The first of this series of communications on the Rhynchota of Kartabo dealt with the Membarcidæ of the area and was published in 1925 (*Zoologica*, vi, No. 3). The present study of the Reduviidæ is based partly on the author's own collections made between June and September, 1922, and partly on the collection formed by other workers at the station in previous years, and which has been placed at the author's disposal by Mr. Beebe. In addition, certain species have been included that were collected in October along the Demerara and Berbice rivers, and which have not yet been recorded from Kartabo, although it is probable that they occur there also. The types of the new species described here are in the British Museum of Natural History. Phylogenetic and bionomic notes are given, and the author describes fifteen new species. M. E. M.

Climatic Observations on Chinch Bugs.—V. E. SHELFORD ("An Experimental and Observational Study of the Chinch Bug in Relation to Climate and Weather," *Department of Education and Registration, Urbana, Illinois, Bull.*, 19, art. vi, 1931, 487-547, 37 text-figs.). Individual variation in the lengths of instars and life histories is very great, probably on account of the sensitivity of the bugs. Low humidity affects the first instar strikingly, and each succeeding stage to a lesser degree. The relations of the rate of development to temperature and humidity are expressible in developmental units, and for each stage an equal velocity chart is presented, similar to those used by the author in his study of the codling moth. The success of the bugs in a long series of cultures shows that their vigour varies from year to year. The bugs were very strong in 1919 and 1925, producing three or four generations in each of the years. They were weakest in 1921. This does not, however, correspond with the severest outbreaks of the bugs in the State. It does indicate the possible importance of internal factors not directly correlated with the immediate surrounding conditions but determined earlier. It is necessary to consider instability in the bugs themselves as well as the instability in the system of Nature of which they form a part. In the early history of the outbreaks in Illinois there was a strikingly correlated connection between human death rate and chinch bug damage. With a better developed agriculture and improved sanitary conditions this relation has become less striking. M. E. M.

Early Stages of Indian Rhipiceridæ.—J. C. M. GARDNER ("The Early Stages of Two Species of Rhipiceridæ (Sandalidæ) from India," *Trans. Entomol. Soc. London*, 79, pt. iii, 1931, 427-30, 1 pl.). The few known larvæ of the Family Sandalidæ (until recently known as Rhipiceridæ) fall into two categories: (1) the very hard-skinned, cylindrical, rotten-wood-boring type (*Callirhipis*); and (2) the soft, fusiform, parasitic type represented by *Sandalus*; the only known larva of the latter genus has been described by Craighead, who points out that although the form and many structures are greatly modified, fundamental characters are not greatly affected by the peculiar habit. Two larvæ are dealt with in this Paper, one from the genus *Callirhipis* and the other from the genus *Parennometes*, and these larvæ are said to be separable by very distinct characters of generic importance. Details are also given of the specific differences of the two larvæ, the subjects being *Parennometes gardneri* van Emden and *Callirhipis nigrescens* van Emden. M. E. M.

The Compound Eye of *Aleurodes brassicæ*.—H. ELTRINGHAM ("On the Structure of the Compound Eye of *Aleurodes brassicæ* Walk. (Hemiptera)," *Trans. Entomol. Soc. London*, 79, pt. iii, 1931, 431-5, 1 text-fig., 1 pl.). The compound eye of the insect is externally divided into an upper and lower portion. The extent of this division varies considerably in related species, being in some incomplete, while in others there is rather wide separation. The special feature of the cornea, to which Dr. C. B. Williams called the author's attention, is the curious fact that the lenses are arranged in groups of seven, of which six are pigmented and lie in rosette formation around the seventh, which is entirely unpigmented. The six coloured lenses are deep yellow, while the seventh is quite colourless. This arrangement is very regular in the lower half of the eye, but less so in the upper half, in which two or more unpigmented lenses are sometimes contiguous. The facettes are laterally compressed into rather irregular masses. The present investigation has been concentrated on the structure of the lower eye, though, except for the fact that its facettes are rather larger, the ommatidial structure appears to be the same in both lower and upper division. The ommatidia of both upper and lower eyes are curved towards one another beneath the cuticle, and become contiguous where they join the brain. The author has carried out a minute analysis of the structure and function of this part of the eye, and also gives his views as to its probable functioning.

M. E. M.

Pattern Abnormality in *Mamestra*.—E. A. COCKAYNE ("An Abnormality of Pattern in Larvæ of *Mamestra pisi*, L.," *Trans. Entomol. Soc. London*, 79, pt. iii, 1931, 437-8, 1 pl.). The abnormality was found to be limited to skin markings, and the abnormal pattern itself is said to follow a definite plan, so that, though no two larvæ are exactly alike, an individual can often be closely matched by another. On Barnes Common in September, 1930, the larvæ of *Mamestra pisi* were very abundant in the broom in one corner of the common, and sixty specimens showing this abnormality were found by the author and Mr. C. M. Hawkins. It was estimated that at least one in twenty was affected in this restricted area. Twice two abnormal larvæ were found on the same shoot, and once three were found close together on a bigger stem. To see more than one of such larvæ on the same bush was of frequent occurrence. Larvæ with this peculiar alteration of pattern evidently occur regularly at Barnes, and they are probably widely spread over Surrey.

M. E. M.

Study of the Genera *Epipaschiinæ*.—A. J. T. JANSE ("A Contribution Towards a Study of the Genera of the *Epipaschiinæ* (Family *Pyralidæ*)," *Trans. Entomol. Soc. London*, 79, pt. iii, 1931, 439-92, 3 text-figs., 10 pls.). The present paper deals mainly with the male characters, and the author's study of these has convinced him that they rank as high as, if not higher than the study of venation. Many of the synonyms have, therefore, been restored to their previous generic position.

M. E. M.

"Sammlung Europaischer Schmetterlinge."—A. F. HEMMING ("New Material Regarding the Dates of the Plates of the *Papiliones* in Jacob Hubner's 'Sammlung Europaischer Schmetterlinge,' with Notes on the Synonymy and Type Localities of Certain Species Described Therein," *Trans. Entomol. Soc. London*, 79, pt. iii, 1931, 493-504.) The title adequately describes the contents of this paper.

M. E. M.

***Pseudococcus* Parasite from Eritrea.**—H. COMPERE (*Univ. Calif. Pub. Entomol.*, 5, no. 14, 1931, 265-74, 3 text-figs.). In the vicinity of Nefasit, Eritrea,

small scattered colonies of the mealy bugs, determined as *Pseudococcus citri*, were collected on the fruit clusters of the wild olive, *Olea chrysophylla*, during March and April, 1930. As it was evident that the mealy bugs were heavily parasitized, and as the author supposed the species to be *P. citri* at the time, an attempt was made to obtain the parasites for introduction into California. In this locality *P. citri* is a pest of minor importance, but as it occasionally infects certain orchards in San Diego County it was hoped to correct the infestation by the importation of the Eritrean parasites. During experimental work with the parasitized *P. citri* two species of *Cheiloneurus* were encountered, but were destroyed as soon as they appeared, since they were thought to be hyperparasites. In addition, eight species of internal parasites issued from the mealy bugs kept in a battery jar. Three of these parasites are described as new. The undetermined parasites include two species of *Anagyrus*, one *Pseudaphycus* sp., one *Leptomastidea* sp., and representatives of one unrecognized genus of which no museum specimens were preserved. The discovery of effective parasites of a form of *P. citri* in Eritrea will be of economic value if the particular biological race which these parasites attack is one injurious to commercial crops in other parts of the world. In the Mediterranean countries, *P. citri* ranks as a serious pest. Whether the Mediterranean race of *P. citri* is the same as the Eritrean or the Californian forms is not known.

M. E. M.

New African Curcursionidae.—G. MARSHALL ("New South African Curcursionidae (Col.)," *Stylops*, 1, pt. 1, 1932, 1-6, 3 text-figs.). Eight new genera and species are described. The names of the species are as follows: subf. *Attelabinae*, *Attelabus* (*Pleurolabus*) *munroi* sp. nov., *A. (P.) spectator* sp. nov.; subf. *Apioninae*, *Apion penicillatum* sp. nov., *A. penicillatum* var. *leptorrhinum* var. nov., *A. penicillatum* var. *basipenne* var. nov.; subf. *Anthonominae*, gen. *Apopnictus* nov. *Apopnictus zizyphi* sp. nov., *Apopnictus longisteis* sp. nov.

M. E. M.

New Trichoptera from Africa and British Guiana.—M. E. MOSELY ("Some New Trichoptera from Africa and British Guiana," *Trans. Entomol. Soc. London*, 79, pt. iii, 1931, 545-51, 21 text-figs.). The following species are described: *Atopsyche spinosa* n.sp., *Chimarra intacta* n.sp., *Psychomyiellodes* gen. nov. (*Psychomyidae*), *Psychomyiellodes unguata* n.sp., and *Setodes squamosa* n.sp.

M. E. M.

New Staphilinidae from the Philippines.—A. BIERIG ("Neue Staphiliniden (Coleoptera) der Philippinen. 3. Beitrag zur Kenntnis der Staphyliniden," *Philippine Journ. Sci.*, 47, no. 4, 1932, 515-21, 1 pl.). The species recorded and described are: *Eleusis augustae* Bernhauer, *Eleusis belua* n.sp., *Eleusis haddeni* n.sp., *Eleusis palawanensis* Bernhauer, *Eleusis derivata* n.sp., *Eleusis semisplendida* n.sp., and *Eleusis multizonata* n.sp.

M. E. M.

New Zealand Mayfly Nymphs.—J. S. PHILLIPS ("Studies of New Zealand Mayfly Nymphs," *Trans. Entomol. Soc. London*, 79, pt. iii, 1931, 399-422, 7 pls.). This study includes an Introduction and notes on Terminology, Origin, Distribution, and Enemies of the Mayflies. Later a description is given of the External Anatomy, which includes the Head, Mouth-parts, Thorax, Abdomen, and the Gills. The work concludes with a description and notes on the Classification, dealing with Keys to Families and Genera, and with the Families Ephemeridae, Siphonuridae, and Leptophlebiidae.

M. E. M.

Anti-Mosquito Sprays.—R. L. HOLT and J. H. KINTER ("Anti-Mosquito Sprays," *Philippine Journ. Sci.*, 47, no. 4, 1932, 433-8). After experimenting with several anti-mosquito spray mixtures which gave efficiency returns of between

14, 13, 24, and 29 p.c., the authors discovered a mixture which gave as high an efficiency result as 87-93 p.c. Sixty grams of powdered pyrethrum are treated with 120 c.c. chloroform for 2 hours with frequent shaking. The fluid is then filtered through a Buchner funnel, the filtrate averaging about 50 c.c. The filtrate is then made up to 1000 c.c. with kerosene. With this anti-mosquito spray it was decided to conduct a test on a large scale. The ward selected was 15 feet high, 40 feet wide, and 164 feet 8 inches long, having a cubic content of 98,800 feet. The wall space measured 6140 square feet. Of this area 1115 square feet were represented by twenty-seven windows and four doors, all of which were simply spaces in the wall covered by screen wire or screened doors. No attempt was made to close any of them. All fans were stopped. Three thousand seven hundred and fifty cubic centimetres of the chloroform extract spray was liberated in the form of a fine mist, and distributed evenly over the ward near the ceiling. This represented 1 c.c. of the spray for each 26 cubic feet (approximately) of air-space. Forty-three patients were present in the ward during the spraying, and for 12 hours afterwards. One hundred *Aedes aegypti* were liberated in this ward, and at the end of 30 minutes ninety of the insects were on the floor of the cage. Three others were overcome during the night. No recoveries were noted in the subsequent 24 hours. Other experiments of a similar kind were carried out with comparable results. The spray is said to be non-toxic to man and small animals.

M. E. M.

Control of *Anopheles minimus* in the Philippines.—P. F. RUSSELL ("The Control of *Anopheles minimus* Mosquito Larvæ in the Philippines by Stranding and Flushing," *Philippine Journ. Sci.*, 47, no. 4, 1932, 439-45, 1 text-fig., 1 pl.). An experiment is reported in which an attempt was made to control *Anopheles minimus* mosquitoes breeding in a small stream by periodically opening and closing the dams situated about half-way along the length of the stream. Quantitative observations showed this simple procedure, done twice on one day a week, brought about a marked reduction in larvæ both above and below the dam, probably by stranding above and by flushing below. It is suggested, on the basis of this first experiment, that such a simple and inexpensive method may be useful in controlling malaria in some areas in the Philippines.

M. E. M.

Description of the Species *Tomaspis bodkini* Williams.—A. PICKLES ("A Description of *Tomaspis bodkini* Williams (Homoptera, Cercopidae), from British Guiana," *Stylops*, 1, pt. 1, 1932, 14-15, 1 text-fig.). In 1916 Mr. C. B. Williams, when Entomologist in Charge of Frog-hopper Investigations, visited British Guiana in search of a frog-hopper parasite which might be suitable for introduction into Trinidad. His report mentions that in that country he investigated chiefly two species of *Tomaspis*, namely, *T. fabrilatera* Urich, and a species undescribed, which was found abundantly on grass on the rubber plantations at Hosororo (Issororo), in the North-West District. A coloured figure of the second species appears in the report under the name *Tomaspis bodkini*, and, although no description has ever been published, this is taken to be an "indication" within the meaning of Article 25 of the International Rules of Zoological Nomenclature. This frog-hopper was again encountered in 1913 at Wauna, North-West District, British Guiana, by Dr. J. G. Meyers, and from the series collected by him the author has been enabled to formulate the description of *Tomaspis bodkini* Williams which is here given.

M. E. M.

Australian Nycteribidae.—H. SCOTT ("Some Nycteribidae from the Australian Region. Part I. Species from the New Hebrides," *Stylops*, 1, pt. 1, 1932

16-24, 6 text-figs.). This and the following Paper includes descriptions of two species of bat-parasites new to science, and a record of a third species from the New Hebrides, an archipelago whence no Nycteribiid had previously been made known; a description of a new species from Fiji; and remarks supplementary to earlier descriptions or bearing on the synonym and geographical distribution of several other species from the Papuan Region, New Caledonia, and Australia. These last are mainly species of Cyclopodia, and it is not attempted to give an account of the entire Nycteribiid fauna of the countries under review except in the case of the New Hebrides. Descriptions are given of *Penicillidia bustoni* n.sp., and *Nycteribia* (*Listropodia*) *bakeri* n.sp.

M. E. M.

New Species of Chelonella (Hym. Brac.).—D. S. WILKINSON ("Some New Species of Chelonella (Hym. Brac.)," *Stylops*, 1, pt. 1, 1932, 6-10, 2 text-figs.). The following five new species are described: *Chelonella cereris* n.sp., *Chelonella malayana* n.sp., *Chelonella socors* n.sp., *Chelonella bedfordi* n.sp., *Chelonella versatilis* n.sp.

M. E. M.

A New Species of Drosophila.—J. R. MALLOCH ("A New Species of the Genus *Zaprionus* Coq. (Diptera, Drosophilidae)," *Stylops*, 1, pt. 1, 1932, 10-11, 2 text-figs.). The genus *Zaprionus* Coquillett was erected for the reception of an African species *Vittiger* Coq., which is until now the only species correctly placed in the genus. Amongst some material recently received from Mr. A. Cuthbertson, of the Department of Agriculture of Southern Rhodesia, one specimen has been found of a new species together with a few specimens of the genotype. The two species are very similar in general colour and size, but may be distinguished by the synoptic table provided by the author. The new species is named *Zaprionus tuberculatus*, and a short description is given of its taxonomic characters.

M. E. M.

New Syrian Butterflies.—A. F. HEMMING ("New and Rare Syrian Butterflies, Lepidoptera, Lycaenidae," *Stylops*, 1, pt. 1, 1932, 12-14, 1 pl.). When last in this country, Mr. R. E. Elison placed at the author's disposal for examination an interesting collection of butterflies which he had been able, during the last three years, to make in the Lebanon. This collection contained a new species of Lycaenid, and also includes a striking new subspecies of *Aricia chiron* Rott. (= *eumedon* Esp.), a species not previously recorded from the Lebanon. The author here gives a description of the latter. Of the former, Herr Ernst Pfeiffer, of Munich, has recently published a description under the name *Lycena ellisoni*. The opportunity is taken, however, of illustrating both sexes of this interesting species, and of figuring the male genitalia. The short description added in supplement to that of Herr Pfeiffer shows that the genitalia are, in this case, of special importance in determining the real systematic position of this species. The name given to this subspecies is *Aricia chiron mylitta* n. subsp.

M. E. M.

Reactions of the Honey-Bee to Light.—L. M. BERTHOLF ("Reactions of the Honey-Bee to Light," *Journ. Agric. Research*, 42, no. 7, 1931, 379-419, 13 text-figs.). The author has conducted experiments in the light of his own opinion and that of other workers in the subject. Special apparatus is used and described, and the whole problem is discussed from many sides. From the results of the experiments conducted it appears that neither the conclusion of Von Frisch and Kuhn that bees distinguish only enormous difference in brightness, nor that of Von Hess that bees are practically as acute as man in this ability, is correct. The more nearly correct conclusion seems to be in the nature of a compromise between

the two, namely, that bees begin to distinguish between illuminated areas when the intensity of one is reduced to at least 70 p.c. of the intensity of the other, whereas human being distinguish between them equally well when the intensity of the one is reduced to only 9 p.c. of that of the other. The author includes a reference list to thirty-seven Papers by other authors. M. E. M.

Carbohydrate Food of Lepidopterous Larvæ.—F. M. BROWN ("The Utilization of Hexose Carbohydrates by Lepidopterous Larvæ," *Ann. New York Acad. Sci.*, 32, 1930, 221–34, 8 tables). The processes of digestion that take place in phytophagous insects have not been thoroughly studied, except, perhaps, in the case of the commercial silkworm, *Bombyx mori* (Aegua, 1916), and the result of these few investigations seemed to be conflicting. The author has selected for his study the general feeding lepidopterous larva *Automeris io*. The conclusions reached are, that hexose sugars probably do not play an important part in the nutrition of *Automeris io* larvæ. Only hexose reducing sugars and disaccharides are utilized by the larvæ. Disaccharides may possibly be made available merely by maceration. Starch is definitely not digested. Calorimetric measurements of the foods used in insect-feeding experiments are important when one is working with natural foods, especially if only partial chemical analyses are made. A synthetic food for phytophagous larvæ has been prepared. References to eleven other writers on the subject are given. M. E. M.

New Tipulidæ from the Philippines.—C. P. ALEXANDER ("New or Little-known Tipulidæ from the Philippines (Diptera), XIII," *Philippine Journ. Sci.*, 47, no. 1, 1932, 163–95, 3 pls.). The crane flies herein discussed are all from Mount Apo, Mindanao, where they were collected by the author's former student, Mr. C. F. Clagg. Keys are provided for the separation of the Philippine species of *Dolichopeza*, *Helius*, and *Pseudolimnophila*. Descriptions are given of twenty-four new species. M. E. M.

The Genus *Spathius*.—D. S. WILKINSON ("On the Indo-Australian and Ethiopian Species of the Braconid Genus *Spathius* (Hymenoptera)," *Trans. Entomol. Soc. London*, 79, pt. iii, 1931, 505–30, 12 text-figs., 1 pl.). Synoptic keys are given to twenty-six species, and the following new species are described: *Spathius cursor* n.sp., *Spathius apotamus* n.sp., *Spathius dissors* n.sp., *Spathius alipes* n.sp., *Spathius vulnificus* n.sp., *Spathius rusticulus* n.sp., *Spathius moderabilis* n.sp., and *Spathius scotti* n.sp. M. E. M.

Butterflies of Jamaica.—W. J. KAYE ("Additions and Corrections to the author's 'Butterflies of Jamaica' (1926)," *Trans. Entomol. Soc. London*, 79, pt. iii, 1931, 531–7, 1 pl.). Since the publication of the Author's "Butterflies of Jamaica" in 1926 ("Trans. Entomol. Soc. London, 1925," 455–504), several people, including the author, have been exploring the island to find additional species. As a result, there are here recorded another fifteen species, raising the total to 106. Of these, two are entirely new, namely, the Lycænid, *Leptotes perkinsæ*, and the Hesperiid, *Epargyreus perkinsi*. M. E. M.

Abnormal Abdominal Structure in Trichoptera.—H. ELTRINGHAM ("On Some Peculiarities of the Abdominal Structure in Certain Male Trichoptera," *Trans. Entomol. Soc. London*, 79, pt. iii, 1931, 539–44, 3 text-figs., 2 pls.). The species so far examined belong to the genera *Diplectrona* (Hydropsychidæ) and *Agapetus* (Rhyacophilidæ). Cleared specimens, *Diplectrona felix* McL., mounted whole, showed that in the male abdomen there were four comparatively large bodies, apparently in the nature of vesicles, the walls of which are chitinous and

beautifully reticulated. They lie ventrolaterally in the fifth and sixth abdominal segments. It seemed probable that they might be of a glandular nature, but the original examples in which they were observed had been treated with caustic, so that any glandular material, if originally present, would not have been preserved. Close examination showed that these structures were actually tracheal expansions, though their meaning, found as they are in the male only, is extremely difficult to imagine. The author describes the minute structure of these expansions.

M. E. M.

Scavenger Flies found in Hides.—F. O'FLAHERTY and Wm. RODDY (*Journ. Amer. Leather Chem. Assoc.*, 1932, 27, 36-9). Descriptions of two instances of hides attacked by the larvæ of *Prodesmometopa latipes* Mg., known colloquially as "skippers." Infection was chiefly around the tail end of the hides. The eggs hatch out into larvæ 3-5 mm. in length, and diameter under 1 mm. The pupæ are barrel-shaped, 2-3 mm. long, and from tan to deep brown in colour. The perfect insect measures 3 mm. from head to tail. The larvæ are killed in from 40-48 hours in 15 p.c. salt solution and in a milk of lime. The larvæ pupate on salted hides, but the tanned leather shows no defects which can be attributed to the insects. Infection of hide warehouses can be overcome by the use of coal tar disinfectants and pyrethrum powder.

A. H.

Platyhelminthes.

Cestoda.

A New Cestode from *Rana clamitans* (Latr.).—CARMEN PHYLLIS OSLER (*Journ. Parasitol.*, 1931, 17, 183-6, 1 pl.). A description of a new species of Proteocephalid tape-worm, *Ophiotenia saphena*. It was found infesting *Rana clamitans* taken from road-side ditches in Cheboygan County, Michigan. J. L.

Trematoda.

Life History of *Schistosomatum douthitti* (Cort.).—HELEN FLORENCE PRICE (*Amer. Journ. Hyg.*, 1931, 13, 685-727, 4 pls.). The author has completed the life history of *Cercaria douthitti* experimentally in rats and mice, and has studied all the stages in detail. *Microtus pennsylvanicus* was found to be the natural adult host. Two new snail hosts were found, *Lymnea palustris* Müller, and *Physa gyrina elliptica* Lea, thus making six species of snail in all known to be intermediate hosts of this parasite. Among interesting new morphological facts discovered is the presence of a cirrus in the male.

J. L.

A New Trematode (*Plesiocreadium parvum* sp. nov.) from Fresh-water Fish.—GEORGE W. HUNTER (*Trans. Amer. Micr. Soc.*, 1932, 51, 16-21, 1 pl.). A minute new trematode, *Plesiocreadium parvum*, from the upper intestine of the long-nosed gar or bill fish, and from the bowfin, is described. A table is also given summarizing the trematode parasites of the genus *Plesiocreadium* taken in New York State from 1928 to 1931.

J. L.

Morphology of *Cotylurus communis* (Hughes) (Trematoda, Strigeidae).—GEORGE R. LA RUE (*Trans. Amer. Micr. Soc.*, 1932, 51, 28-47, 4 pls.). A detailed description of the adult generation of *Cotylurus communis* Hughes is given for the first time. The material was taken from the bursa Fabricii of young herring-gulls fed experimentally on trout perch from Douglas Lake, Cheboygan County, Michigan. Heavy infections of the parasite produced marked emaciation.

and also paralysis of the leg muscles by the seventh or eighth day after feeding, and death usually followed on the twelfth or fifteenth day. The parasite was also found to occur naturally in small numbers in the bursa Fabricii and intestine of nestling herring-gulls taken from the islands of Lake Huron, and also in the intestine of adult gulls. Heavy infestations in the young gulls caused great enlargement of the bursa.

J. L.

Nemathelminthes.

Immunity Reactions of the Dog against Hookworm (*Ancylostoma caninum*) under Conditions of Repeated Infection.—O. R. MCCOY (*Amer. Journ. Hyg.*, 1931, 14, 268–303). Using repeated infection of *Ancylostoma caninum* larvæ, the course of infection was followed in twenty-five dogs over periods of 6–9 months by means of egg counts, Hb content of the blood, and recovery of adult worms from the stools. Several dogs died as a result of too rapid initial infections. In six cases of heavy infection the egg count rose during the first 3 months to a peak of several million eggs per day. Hb in these dogs dropped to 25 p.c. Two dogs died, but in four a crisis occurred, and the egg count dropped to a comparatively low level. Large numbers of worms were passed in the fæces and the Hb gradually rose to normal, though large doses of larvæ were still being given. This apparent immunity reaction on the part of the host was not absolute, as subsequent infections after loss of the first were thrown off similarly but more rapidly. In ten of the resistant dogs the egg production per female worm diminished to one-third of the normal figure. It was difficult to separate acquired immunity from age resistance in lightly infected cases, but apparently previous infection conferred some degree of immunity. Six cats repeatedly infected with a cat strain of *Ancylostoma caninum* showed an increased resistance apparently distinct from any age effect. The occurrence and degree of eosinophilia varied and could not be directly correlated with resistance.

J. L.

The Morphology and Life History of the Fowl Nematode *Ascaridea lineata* (Schneider).—JAMES E. ACKERT (*Parasitol.*, 1931, 23, 360–79, 25 text-figs., 3 pls.). The material for this study, comprising 220 adult *Ascaridia*, was obtained from chickens at Manhattan, Kansas, U.S.A., and from Cambridge, England. The adult morphological and the developmental characters of this parasite are fully described and figured. It was noted that the eggs arising in the anterior ovary passed into the posterior uterus, and *vice versa*. The small structure visible at one pole of the egg, previously described as an opercular plug, or as an internal thickening of the shell, was really a solid conical appendage of the vitelline membrane. In water cultures it was found that keeping the fertile eggs at 10° C. for 1 month had no deleterious effect on them when incubated subsequently at 30° C., but that refrigeration at 0° C. for the same period impaired their vitality. Infection of the chicken's duodenum was acquired normally through ingestion of embryonated eggs. It was also found that larvæ 10–17 days old frequently penetrated the duodenal mucosa of young chickens, but normally after the seventeenth day they withdrew into the lumen of the intestine. The worms reached maturity in 50 days in chickens parasitized at 1 month old, during which time at least three moults occurred.

J. L.

Nematode Parasites of Mammals, with a Description of a New Species, *Wellcomeia branickii*.—GERVASE W. MCCLURE (*Zoologica*, 1932, 15, 1–28, 1 pl.). The nematodes here described formed a collection from mammals that died in the New York Zoological Park during 1930. Among them were males of a new species

of *Wellcomeia* from the Branick rat. Synoptic lists of both mammal hosts and of the nematode parasites are given. J. L.

On a Nematode Parasite of Psyllids.—M. R. PUSSARD ("Sur un nématode parasite de Psyllides," *Compt. Rend. Séances Acad. Sci.*, 1932, 194, 493-4). The author describes the finding of immature larvæ of *Mermis* in certain Psyllids, and this is the first record of this parasite in the Homopterous Hemiptera. The species parasitized were *P. alni*, *P. forsteri*, and *P. viburni*. (The last-named host had not previously been recorded in France.) Although causing no external change in the host other than slight distension, on section the worms were found to destroy the ovaries and much of the fatty tissue. J. L.

***Trionchonema rusticum* n.g. n.sp., a Parasitic Nematode from the Land Snail *Polygyra espicola* Bland (Helicidae).**—HANS A. KREIS (*Trans. Amer. Micr. Soc.*, 1932, 51, 48-56, 2 pls.). The snails found parasitized by this new nematode were collected in City Park, New Orleans, and though repeatedly examined the infection was only found on one occasion. The parasite, which is described and figured, though morphologically distinct resembled *Strongyloides*, and the possibility of an as yet undiscovered, free-living, rhabditiform stage in the life history is mentioned. J. L.

Helminthological Researches in Hamburg. Monograph on the Family Cosmocercidae Trav., 1925 (Nematoda).—LAURO TRAVOSSOS ("Pesquisas helminthologicas realizadas em Hamburgo. IX. Ensaio monographico de familia Cosmocercidae Trav. 1925," *Mem. Inst. Oswaldo Cruz*, 1931, 25, 237-98, 43 pls.). In an opening discussion, the various existing classifications of the Oxyuridae (s.l.) are considered, with special reference to the classifications of Railliet and Henry, York and Mapleston, and of Baylis and Daubney. In the present work the order Oxyurata is divided into two super-families. The Oxyuroidea, or monospiculate forms, and the Subuluroidea, or bi-spiculate forms. Into the latter are grouped the following families: Subuluridae, Kathlaniidae, Cruzidae, Heberakidae, and Cosmocercidae. The characters of each of these families are briefly outlined, and a key is given to the genera of the Cosmocercidae. This here includes the genera *Cosmocerca*, *Aplectana*, *Oxystomatium*, *Protostomayria*, *Cosmocercella*, *Syphaciella*, *Schrankia*, *Raillietnema*, *Cosmocercoides*, and *Oxysomoides*. In all, forty-five species of the Cosmocercidae are described. They are fully illustrated in the plates which follow. J. L.

Rotifera.

The Hatching of a Loricated Ploimid.—L. VARGA (Sopron) ("Beiträge zur Kenntnis der Rotatorien Fauna des Balaton-Sees. Das Ausschlüpfen der jungen Individuen von *Anurca cochlearis* var. *macracantha* Lauterborn aus dem Embryosack," *Arb. I. Abt. Ung. Biol. Forsch. Inst.*, 1930, 60-69, 7 text-figs.). During his study of the Winter Rotifer Fauna of the Balaton Lake, the author has found the above-named variety of the familiar rotifer *Keratella cochlearis* Gosse to be the dominant form of its class at that season, and he has taken the opportunity to watch very carefully what exactly takes place when the young animal breaks its way through the shell and its subsequent progress. In one respect the rotifer named is typical of quite a number of Ploimid species, comprising all the Brachionidae, the Filiniidae, some of the Synchronidae, and others, and that is that the eggs produced by the female are neither dropped where the parent happens to be at the moment of extrusion, nor affixed by some adhesive secretion to the leaf or stem of a water-plant, but are retained in connection with the body and

carried about with it, as the mother wanders here and there, at least until the embryo has so far progressed in development that it can escape to lead its own life. It was found that, when breaking through the shell, the young individual, in most cases, does so with success near that pole of the egg which confines the hinder part of its own body, where the strong posterior spine, being still in a soft condition, is bent down below the venter. If, on the contrary, it cracks the shell in the vicinity of its own head, as sometimes happens, the blunt-ended head is usually unable to make further advance towards freedom and the young animal dies. After complete emergence, which may require from 8-12 minutes, all the spines, hitherto bent over inwards to the body, gradually unbend and slowly assume the form and stiffness of the adult, whilst the whole lorica, with its distinctive alveolæ on the dorsum, as gradually hardens into the characteristic hollows and ridges. This completion of development may consume some 12-24 hours. When the first egg of the young individual becomes distinguishable within the body, it can be seen to have made already some progress in its development. The author is thereby induced to consider that the so-called egg is not a true egg, since it contains an embryo when extruded, and that consequently its covering would appropriately be termed an embryo-sack, as he has himself called it in his title. He suggests that the like is the case with the eggs of the other species, which carry them about until they hatch out.

D. L. B.

Remarkable Rotifer Fauna of a Small Island.—FRANK J. MYERS ("The Distribution of Rotifera on Mount Desert Island," *Amer. Mus. Novitates*, 1931, no. 494, 1-12). In the small island named, on the coast of Maine, U.S.A., the author reports the capture, during the summer months of the years 1922-31 inclusive, of 449 species of Rotifera, of which nearly a hundred are awaiting description, and there are now listed the names of 353 species, a large proportion consisting of forms as yet unknown outside the U.S.A. When it is stated that the island contains only about 105 square miles of territory, one wonders what is the happy combination of favourable conditions which have rendered possible such varied collections as are here indicated. The lay-out of the island is briefly described and a list is given of thirty principal collecting stations, with particulars of their situation and of the pH value of the water in each case. The most of the bodies of permanent water are poor in mineral salts and the average hydrogen ion concentration is consequently under 7.0. Only one of the stations is reported as including Sphagnum pools, and, at the other end of the scale, two stations are described as marine. Amongst the others are conspicuous a series of mountain lakes, which proved very productive. The majority of the forms belonged to the order of the Ploima, but members of the orders of the Bdelloida, Flosculariaceæ, and Collothecaceæ were not especially searched for, although, when observed, they were recorded. This paper will be particularly useful to experts who have themselves a wide experience in collecting.

D. L. B.

Protozoa.

'Excystation of Coccidia.—J. ANDREWS ("Excystation of Coccidial Oocysts *in vivo*," *Science*, 1930, 71, 37). The author uses the following method to produce excystation of the oocysts of coccidia *in vivo*. Ripe, segmented oocysts are concentrated by centrifugation and washed, if necessary. They are then suspended in a few drops of sweet milk. The material is fed to a starved young rat. An hour later the rat is killed and the intestine removed. By examining various parts of the intestine all stages of excystation, including motile sporozoites, may be found.

C. A. H.

Human Intestinal Protozoa in the Temperate Zone.—J. ANDREWS and M. PAULSON ("The Incidence of Human Intestinal Protozoa, with Especial Reference to *Endamoeba histolytica* in the Residents of the Temperate Zone," *Amer. Journ. Med. Sci.*, 1931, 181, 102). A report on a survey of human intestinal protozoa, with special reference to *Endamoeba histolytica*, conducted among adults attending the outpatient department at Baltimore. The results are compared with those obtained four years earlier. In the present case the material was obtained from persons residing in their own homes, whereas the majority of similar investigations were among institutional and military classes. It is claimed, therefore, that the results reported in this paper represent more accurately the incidence of intestinal protozoa in residents of the temperate zone as a whole. The findings were as follows: In 522 cases studied (1927 and 1931) the total incidence of human protozoa infesting the intestinal tract was 10.9 p.c., the species being distributed in the following proportion: *Endamoeba histolytica*, 0.2; *E. coli*, 4.2; *Endolimax nana*, 2.5; *Iodamoeba bütschlii*, 1.3; *Trichomonas hominis*, 2.1; *Chilomastix mesnili*, 1.3; *Giardia lamblia*, 2.7; *Embadomonas intestinalis*, 0.2. C. A. H.

Experimental Giardiasis in Man.—H. TSUCHIYA and J. ANDREWS ("A Report on a Case of Giardiasis," *Amer. Journ. Hyg.*, 1930, 12, 297-8). One of the authors accidentally infected himself with cysts of *Giardia lamblia*. In the present paper are recorded the clinical observations on this case. A number of symptoms (diarrhoea, pain, headache, nausea, etc.) are attributed to the infection. These remained only as long as cysts were present in the stool. Moreover, the subject had previously been free from the attacks, and no parasites had been found in his stools, which were examined regularly before the symptoms appeared.

C. A. H.

The Parabasal of Trichomonads.—H. KIRBY, Jr. ("The Structure and Reproduction of the Parabasal Body in Trichomonad Flagellates," *Trans. Amer. Micr. Soc.*, 1931, 50, 189-95, 1 pl.). A critical consideration of the view advanced by Duboscq and Grassé, according to which the parabasal apparatus of certain flagellate protozoa is homologous to the Golgi apparatus. The evidence brought in support of this view is discussed *seriatim*. (1) It was stated that acetic acid destroys the parabasal, but by using Delafield's hæmatoxylin or Mallory's triple stain, after fixation with reagents containing acetic acid, the author has shown that the parabasal remains intact. (2) He also demonstrated the presence of the parabasal by methods which do not show mitochondria or Golgi apparatus. (3) The chromophile and chromophobe structure of the parabasal is confirmed, but by staining with Delafield's and Regaud's hæmatoxylin the author has shown that the "chromophobe" part is composed of stainable granules, and not of vesicles. (4) The secretory properties of the parabasal claimed in support of its affinity to Golgi apparatus could not be confirmed. (5) The author also failed to observe reproduction of the parabasal body by splitting in the polymastigote and hypermastigote flagellates.

C. A. H.

Protozoa in the Duodenum.—M. PAULSON and J. ANDREWS ("The Incidence of Human Intestinal Protozoa in Duodenal Aspirates," *Journ. Amer. Med. Assoc.*, 1930, 94, 2063-65). Duodenal aspirates were examined from seventeen healthy human adults, presenting various protozoa in discharged specimens of faeces. The object was to ascertain which of the parasites inhabited the duodenum. *Giardia lamblia* was the only protozoon found in this situation. The author was thus unable to confirm the results of some previous observers who claim to have

found various intestinal flagellates and amoebæ in the duodenum and biliary tract of the cases observed by them. C. A. H.

Ciliate Parasitic in Mollusc.—E. WARREN ("On a Ciliate Protozoon Inhabiting the Liver of a Slug," *Ann. Natal Mus.*, 1932, 7, 1-53, 7 text-figs., 1 pl.). Description of a hymenostomatous ciliate, *Paraglaucoma limacis* gen. n., sp. n., living as a facultative parasite in the liver tubules of an African slug, *Agriolimax agrestis*. This protozoon grows readily in cultures and has been found in the wild state. It appears to be related to the genus *Glaucoma*, but differs from it in the absence of a perceptible pharynx. Slugs become infected by swallowing the free forms with moist earth and vegetable matter. The ciliates find their way through the hepatic ducts into the liver tubules, where they reproduce by fission. They are discharged with the fæces via the stomach. The parasite or messmate appears to be harmless to the host. Observations on the nucleocytoplasmic index, and on the reconstructive processes in the macronucleus, leading to its rejuvenation, are recorded. Conjugation is exceptional, while endomixis was not observed. C. A. H.

Termite Flagellates.—H. KIRBY, Jr. ("Trichomonad Flagellates from Termites. II. *Eutrichomastix*, and the subfamily Trichomonadinae," *Univ. Calif. Pub. Zool.*, 1931, 36, 171-262, 4 text-figs., 9 pls.). A review of the species of Trichomonadinae from termites, including seven new species and a new genus. *Eutrichomastix acostylis* n.sp. is described from *Nasutitermes* (*Subulitermes*) *kirbyi*. New subfamilies—Polymastiginae, Devescovicinae, and Trichomonadinae—of the family Trichomonadidae are proposed. A description is given of the following new forms: *Trichomonas barbouri*, *T. cartagensis*, *T. linearis*, *T. labelli*, *Tritrichomonas brevicollis*, *T. holmgreni* spp. n., *Pentatrichomonoides scroa* gen. n., sp. n. A special section is devoted to the cytology of the flagellates studied. A series of granules, staining with Delafield's hæmatoxylin, is found in the parabasal body of *Trichomonas termopsidis*. The old parabasal is resorbed and two new ones differentiated in the prophase of mitosis. It is suggested that this is the general method of origin of this structure in the family. A parabolepharoplastic bar, from which a filament leads to the nucleus, is described for the first time in *Trichomonas*. In all the species described the blepharoplast is a single mass, flattened on one side or crescentic, and in some it is composed of several granules embedded in a common matrix. A rhizoplast was observed only in some of the species. Two types of nuclei are recognized in the Trichomonadinae: one in which the nucleus is filled with granules of chromatin, and one in which the structure resembles that of *Endameba*, with a small central mass and peripheral chromatin. C. A. H.

Nomenclature of an Amoeba.—S. O. MAST and P. L. JOHNSON ("Concerning the Scientific Name of the Common Large Amoeba, usually Designated *Amoeba proteus* (Leidy)," *Arch. Protistenk.*, 1931, 75, 14-30, 3 pls.). A discussion on the nomenclature of *Amoeba proteus* Leidy, 1878. According to Stiles it is identical with Rösel's "Proteus" (1755), to which Linnæus gave the names *Volvox chaos* (1758) and *Chaos protheus* (1767), and it should, therefore, be known as *Chaos chaos*. The present authors find that Rösel's organism was actually a myxomycete and hold that, Leidy's description being the only one that answers to the specific identification, the name *A. proteus* should be retained. C. A. H.

Locomotion in Amoeba.—S. O. MAST ("Locomotion in *Amoeba proteus* (Leidy)," *Protoplasma*, 1931, 14, 321-30, 3 figs.). Locomotion in Amoeba involves four processes: attachment to substratum, gelation of plasmasol at the anterior

end, solation of the plasmagel at the posterior end, and contraction of the plasmagel at this end. Gelation of the plasmasol at the anterior end extends the plasmagel tube forward as rapidly as it is broken down at the posterior end by solation. Contraction of the plasmagel tube at the posterior end drives the plasmasol forward. The *Amœba* being a turgid system, the plasmagel is continuously under tension. Since it is elastic it is pushed out at the region where its elasticity is lowest, with the result that pseudopodia are formed.

C. A. H.

Local Stimuli in *Amœba*.—S. O. MAST ("Localized Stimulation, Transmission of Impulses, and the Nature of Response in *Amœba*," *Physiol. Zool.*, 1932, 5, 1-15, 3 figs.). Description of experiments on the effect of localized photic stimulation in various *Amœbæ* (*Amœba proteus*, *A. dubia*, *A. doffleini*, *A. X.*). The light used for localized stimulation consisted of the image of the luminous filament of a monoplanes-filament stereo-opticon lamp, produced by means of the substage condenser of a binocular mono-objective microscope, and reflected by means of the plane substage mirror. The following is a summary of the results: Increase in the illumination of the hyaline cap of *Amœba* has no effect; increase of the illumination of the plasmagel sheet produces cessation in streaming at the tip and results in the formation of lateral pseudopodia near the tip; increase in illumination of the anterior end posteriorly to the plasmagel sheet causes cessation of streaming in the entire organism; increase in illumination of any portion of the posterior part of the body increases the rate of streaming and causes the animal to become thinner and longer. Light causes gelation of the plasmasol adjoining the plasmagel, making it thicker and increasing the elasticity of the portion illuminated. Response to light is due to contraction of the plasmagel in the region stimulated.

C. A. H.

Effect of Electricity upon *Amœba*.—S. O. MAST ("The Nature of the Action of Electricity in Producing Response and Injury in *Amœba proteus* (Leidy) and the Effect of Electricity on the Viscosity of Protoplasm," *Z. vergl. Physiol.*, 1931, 15, 309-28, 3 text-figs.). Experiments were conducted with the object of determining the effect of electric current on cytoplasm and the nature of response in *Amœba* to electricity. *Amœba proteus* and *A. doffleini* were employed and direct and alternating current was obtained from the lighting circuit, using platinum poles. These were applied to the edges of the coverslips under which cultures of *amœbæ* were mounted. It was found that *A. doffleini* does not respond to electric current. *A. proteus* is orientated very definitely in a galvanic current and moves toward the cathode. If the anterior end is directed toward the cathode when the circuit is made there is increase in the rate of streaming. If it is weak this increase is slight; if it is strong the anterior end spreads out and the posterior end contracts; if it is still stronger the *amœbæ* disintegrate. If the posterior end is directed toward the cathode the rate of streaming decreases beginning at the cathodal end. Retardation in streaming is followed by reversal in its direction at the posterior end, while it continues in the opposite direction at the anterior end. The responses are due to the solating action of the current on the plasmagel on the side directed toward the cathode, and contraction of the plasmagel in adjoining regions. The rôle of ions in determining these changes is explained. In alternating current the *Amœba* orients and moves at right angles to the direction of the current.

C. A. H.

Response to Light in *Amœba*.—S. O. MAST ("The Nature of Response to Light in *Amœba proteus* (Leidy)," *Z. vergl. Physiol.*, 1931, 15, 139-47, 2 text-figs.). Observations were made to determine the nature of the response in *Amœba proteus*

to rapid increase in illumination. Directive illumination causes *Amoeba* to respond by orientation which is negative in strong light and positive in weak light. In the former case the formation of pseudopodia is inhibited on the more highly illuminated surface, and this is due to increase in the elastic strength of the plasmagel on this side. If the intensity of the light is rapidly and greatly increased all movement ceases, but if it is slightly increased there is only a slight temporary retardation in the rate of streaming at the tip of the advancing pseudopodia. Cessation of streaming is due to gelation produced by the light, increasing the thickness and elasticity of the advancing pseudopodia. The magnitude of gelation is correlated with the extent of increase in luminous intensity. The smaller this is, the less the gelation and the retardation in the rate of flow.

C. A. H.

Development and Cytology of the Sporozoa.—A. NAVILLE ("Les sporozoaires (cycles, chromosomiques et sexualité)," *Mém. Soc. Phys. & Hist. Nat. Genève*, 1931, 41, (1), 1-223, 150 text-figs., 3 diagrams). A monographic comparative account of the cytology and life-cycle of the Sporozoa, with special reference to their chromosome cycle and sexual phenomena. The work is divided into four parts. The first two are devoted to a review of the known facts concerning the development and cytology of the Neosporidia and the Telosporidia. The third part deals mainly with the nuclear structure of the Sporozoa, as compared with that of other protista and of the Metazoa. The fourth part is devoted to the sexual phenomena in these parasites, with special reference to "sexual polarity." The scope of this work is too wide to be dealt with adequately in a short review, and the reader is referred to the original for particulars. The monograph is profusely illustrated with black-and-white line drawings. It is provided with a very complete bibliography and a glossary of terms. At the end of the book three synoptic tables of the life-cycles within the main groups are given.

C. A. H.

New Foraminifera from the Miocene of Florida.—J. A. CUSHMAN and G. M. PONTON ("Some Interesting New Foraminifera from the Miocene of Florida," *Cont. Cushman Lab. For. Res.*, 1932, no. 116, 1-4, pl. i, figs. 1-7). The Lower Miocene of Florida, especially the Chipola marl, represents shallow warm water conditions which were very similar to conditions now prevailing in the shallow water of the general West Indian and Florida regions. It contains many new species and varieties. In anticipation of a general report to be published by the Florida State Geological Survey, the authors describe and figure two new genera, *Annuolocibicides* and *Rectocibicides*. They also record a new species, *Cycloloculina miocenica*. The genus *Cycloloculina*, first described in the Journal of this Society in 1908 from Selsey, has since been recorded from the Eocene of both Europe and America. Its range is now extended to the Miocene, and as it has a very short vertical range in both formations, it should form an excellent index fossil. Its discovery in the Oligocene may now be anticipated.

A. E.

A New Cretaceous Genus.—J. A. CUSHMAN ("*Rectogumbelina*, a New Genus from the Cretaceous," *Cont. Cushman Lab. For. Res.*, 1932, no. 117, 4-7, pl. i, figs. 8-12). Numerous forms arising from *Gumbelina* by the addition of more complex types of development have been described under various generic names. The general characters of *Rectogumbelina* are parallel with *Bigenerina* in the Textulariidae, but the early stages show its direct development from *Gumbelina*, and the wall is calcareous and finely perforate. The early chambers are arranged biserially and are followed by numerous uniserial inflated chambers, round in section and separated

by depressed sutures. The aperture in the early stages is similar to *Gumbelina*; in the adult it is rounded and terminal with a distinct neck. Two new species are described and figured from the Upper Cretaceous of Texas and adjacent regions. A. E.

The Genus *Virgulina*.—J. A. CUSHMAN ("Notes on the Genus *Virgulina*," *Cont. Cush. Lab. For. Res.*, 1932, no. 118, 7-23, pl. 2-3). *Virgulina* d'Orbigny, 1826, has a range from the Lower Cretaceous to the present time. It is a development from *Bulimina* and the early stages of most species are definitely a triserial spiral, the later chambers usually taking on a twisted biserial form. Owing to the general absence of ornament specific identification is difficult, and it is probable that two specific names in particular, *V. schreibersiana* Czjzek and *V. subsquamosa* Egger, have been used to cover a multitude of systematic sins. With the view of assisting workers who have not access to original publications, the author reproduces tracings of the original figures of most of the recorded species, with brief descriptions and notes. The species are arranged in geological sequence, and a new subgenus, *Virgulinella*, is created for those species characterized by a superficial ornament caused by finger-like extensions of the sutures extending backwards over the surface of the preceding chamber. This curious form of ornament appears to be confined to species of Miocene age both in Europe and America. A. E.

Mediterranean Textularidæ.—E. LACROIX ("Textularidæ du plateau continental méditerranéen entre Saint Raphael et Monaco," *Bull. de l'Institut. Ocean.*, 591, 1932, 1-28, 33 text-figs.). Fourteen species in all are described and adequately figured by means of woodcuts, particular attention being devoted to the differences exhibited by the megalospheric and microspheric forms. They include a new species of *Spiroplectammina*, *S. typica*, distinguishable from *S. bififormis* by its highly compressed form and the trapezoidal shape of its chambers, and four new species of *Textularia*, *T. elegans*, *T. pseudorugosa*, *T. bigenerinoides*, and *T. cochleata*. The last two are characterized by the situation of the aperture at the extremity of a produced neck, an uncommon feature in the Textulariinae which may eventually justify their removal to a new subfamily. The author has been unable to confirm the occurrence of *T. conica* d'Orbigny in the area. Many specimens comparable with the figures of later authors were found, but after careful examination were rejected as young individuals of other local species. A. E.

Australian Foraminifera.—W. J. PARR ("Victorian and South Australian Shallow-water Foraminifera—Part I," *Proc. Roy. Soc. Victoria*, 1932, 44, (1), (n.s.), 1-14, 1 pl.). The foraminifera of this area have already been dealt with by Parker and Jones (1865), Howchin (1890), and Chapman (1909). The author has been working in the district for several years, and this is the first of a series of papers intended to deal with new and otherwise interesting species. All the materials examined were either shore sands or from very shallow water, and several new species are described, including *Proteonina spiculifera*, *Reophax friabilis*, *Quinqueloculina australis*, *Q. ammophila*, and *Bolivina subreticulata*. Additional details of structure and distribution are given respecting a number of other species already known from this area. The illustrations, on the whole, are very good, though some are too small to exhibit the necessary details. A. E.

A New Foraminiferal Genus.—HELEN J. PLUMMER ("Ammobaculoides, a New Foraminiferal Genus," *Amer. Midland Nat.*, 1932, 13, (2), 86-8, 1 text-fig.). *Ammobaculoides navarroensis*, the genotype, occurs frequently in a shale of Navarro

age (Upper Cretaceous) at Webberville, Texas. The test is adventitious and elongate, the earlier chambers arranged in a compressed coil, followed by a biserial and somewhat compressed series, finally becoming uniserial and uncompressed. The aperture in the first stage is an arch at the base of the septal face, an elliptical slit in the septal face in the second stage, and in the final stage terminal and round. The proloculum is very variable in size, but no indubitable microspheric form has been identified. The author regards her new genus as closely linked with *Ammobaculites*, but the evidence seems rather to point to an affinity with *Spiroplectammina*.
A. E.

Upper Cretaceous Foraminifera of Trinidad.—J. A. CUSHMAN and P. W. JARVIS ("Upper Cretaceous Foraminifera from Trinidad," *Proc. U.S. Nat. Mus.*, no. 2914, 1932, 1-60, 16 pls.). Some work has already been published on this subject, but further collections have considerably increased the fauna. The material represents a rather deep-water deposit, and many of the genera and species are still existent in the deeper waters off the Trinidad coast, indicating that the conditions under which the material was deposited were not very different from those prevailing at the present day. The arenaceous species are often badly distorted by pressure, but the calcareous forms are usually well preserved. Seven new species and three new varieties are described, and there is a useful bibliography of papers on the foraminifera (exclusive of Orbitoididae) from the American Upper Cretaceous. The illustrations are admirable and will be of the greatest value to students.
A. E.

Fossil Foraminifera.—A. LIEBUS ("Die Fossilen Foraminiferen, eine Einführung in die Kenntnis ihrer Gattungen," Prague, 1931, 1-159, 348 text-figs.). Nearly a third of this little book is occupied with preliminary chapters on research methods, the structure and development of the shell, secondary ornament, dimorphism and trimorphism, systematics, and the biology of the order. The rest consists of brief descriptions of every genus recorded as fossil, with its geological range and a small woodcut of a typical species sufficiently clear for general identification. The work is obviously intended for persons having no systematic knowledge of Foraminifera, the genera being arranged according to external form without regard to affinities. Thus it starts with the *Lagenaler-Typus*—the single-chambered types—which are subdivided into those with (1) agglutinate, (2) calcareous perforate shells. This obviously leads on to the next section, the *Perlschnur-Typus*, in which the chambers are arranged in line like a row of pearls, subdivided into agglutinate, chitinous, calcareous-imperforate and calcareous-perforate groups. Then the *Flachspiraler-Typus*, which necessitates several additional subdivisions; and so we go on, each *Typus* becoming more complicated in its subdivisions and containing more entirely unrelated forms. The author has displayed considerable ingenuity in bringing some of the more complicated structures into general line, but the question arises with the abstractor whether, if he were beginning again, he would not prefer to master even the most complicated system of scientific classification rather than be dependent on looking through some 300 pictures for one which matches his specimen.
A. E.

Fossil Foraminifera from Tennessee.—J. A. CUSHMAN ("A Preliminary Report on the Foraminifera of Tennessee," *Bull. 41 Div. Geol. State of Tennessee*, 1931, 1-112, 1 text-fig., 13 pls.). Difficulty having been experienced by oil explorers in separating the rock formations, the State of Tennessee has projected a formal survey of the Eocene and Cretaceous strata. With few exceptions the Eocene samples have proved to be barren of foraminifera, while the Cretaceous

collections are rich and the specimens well preserved. The fauna is very similar to that in European beds of similar age. Ten new species and three new varieties are described, and about a hundred forms are listed and admirably illustrated. It is stated that there are numerous other species beside those figured and described, a selection having been made of the species most likely to be useful for the correlation of strata in future work.

A. E.

Tertiary Foraminiferous Strata in East Indies.—W. LEUPOLD and I. M. VAN DER VLIERK ("The Tertiary," *Leidsche Geol. Mededeelingen (Feestbundel K. Martin)*, 1931, 5, 611-48, 2 tables). As Prof. K. Martin laid the foundations of the stratigraphy of the Dutch East Indies, a study of the Tertiary deposits of that area is a very suitable publication in honour of the Professor's jubilee. The fauna is autochthonous, and as the fossils cannot be compared with European Tertiary fossils, it is not possible to apply the names current for European strata. The basis for the subdivision into stages and horizons is formed by the foraminifera. The deposits of the various islands are treated at some length as identified by the dominant foraminifera. There are two large tables, one showing the succession of strata in the different island groups, the other showing the distribution of the most important genera and species of larger foraminifera in these successive strata.

A. E.

East Indian Tertiary Foraminifera.—J. H. F. UMBGROVE ("Tertiary Foraminifera," *Leidsche Geol. Mededeelingen (Feestbundel K. Martin)*, 1931, 5, 35-91). In his review of the palæozoology of Java, Prof. K. Martin in 1919 recorded forty-nine species of foraminifera from Tertiary strata, mainly on the strength of his own study of the fossils. In celebration of the Professor's jubilee, Umbgrove lists more than 640 species for the whole of the East Indian Archipelago, and states that a much greater number are scattered through the very extensive geological literature of the region. Following the list are stratigraphical sections dealing with the distribution of the larger genera, which alone have been worked out in any palæontological detail. In comparison with the Orbitoididæ, Camerinidæ, etc., very little detailed work on the smaller foraminifera has been published, as the oil companies, which use them for stratigraphical correlation, keep their data secret. There is a very complete bibliography of 139 publications bearing on the East Indian Region.

A. E.

Venezuelan Fossils.—N. E. GORTER and I. M. VAN DER VLIERK ("Larger Foraminifera from Central Falcon (Venezuela)," *Leidsche Geol. Mededeelingen*, 4, (2), 1932, 94-122, pls. 11-16, 2 text-tables). The material was collected by the geologists of the North Venezuelan Petroleum Company and gives a good idea of the distribution of the larger foraminifera in seven stages of the Tertiary in this district of Venezuela. In order to obtain a survey of the numerous species of *Lepidocyclus* described from America, a determination table was compiled. The authors conclude that many specific names have been introduced which cannot be maintained. Pending a revision of his material they reject the whole of the seventy-one new species described by W. Berry in 1929 from the Verdun formation of North-Western Peru, on the grounds of insufficiency of illustration and because it would appear that specimens rather than species have been described. It is not possible to correlate the local stages of the Tertiary of Central America with the standard subdivision of Europe or with that of the Far East, as the genera and subgenera of larger foraminifera show a very different distribution in America. Fifteen species of *Lepidocyclus* and *Discocyclus*, five of which are new species, are described with details of their

occurrence in other regions. The illustrations are from photographs, and, though adequate, suffer from all the drawbacks attached to this medium when applied to foraminifera. A. E.

Mexican Fossils.—W. L. F. NUTTALL ("Lower Oligocene Foraminifera from Mexico," *Journ. Palæont.*, 1932, 6, (1), 3-35, 9 pls.). One hundred and thirty-five species and varieties of smaller foraminifera have been identified from the Alazan strata of the Tampico Embayment, Mexico, which is of Oligocene age. Twenty-three new species and five new varieties are described. By means of the foraminifera it is possible to divide the Alazan shale into lower and upper divisions, numerous species which occur in the former being absent from the latter. The paper is copiously illustrated by means of drawings and photographs. Of the drawings it is sufficient to say that they are the work of Miss Margaret Moore, who has few equals as an illustrator of this order. Microphotographs of the foraminifera, particularly of the smaller species, are, however, of little use to illustrate specific differences. A. E.

Tertiary Borings in Victoria.—F. CHAPMAN and IRENE CRESPIN ("The Tertiary Geology of East Gippsland, Victoria: as shown in Borings and Quarry Sections," *Palæont. Bull.*, 1 (published by Department of Home Affairs, Melbourne), 1932, 1-15, 2 maps, 1 pl.). The discovery of petroleum in Gippsland has resulted in considerable drilling activity, and a large amount of sub-surface information has been collected which supplements to a very important degree the meagre details obtainable by the ordinary geological survey. The authors have been engaged for four years in the study of the material obtained from various borings, full details of which are given. From these details they have found it possible to obtain conclusive evidence of the sequence and age of the beds in East Gippsland. It has been shown conclusively that there exist a number of well-defined and recognizable "marker-beds," which can be relied on in drilling operations as "geological landmarks," by the aid of which the structure of the petroliferous basin can be elucidated. The plate illustrates six species of Foraminifera and four species of Mollusca, which are typical Tertiary fossils, from the borings and quarries. A. E.

New Nomenclature.—L. A. J. BAKX ("De Genera *Fasciolites* en *Nealveolina* in het Indo-Pacifische Gebied," *Verhand. Geol. Mijnbouwkundig Genoot. voor Nederland en Kolonien. Geol. Ser.*, 9, (3), 1932, 205-66, 2 text-figs., tables, 4 pls.). Nomenclature nowadays alters so frequently that only the specialist can keep pace with the changes. For generations *Alveolina* was a fixed and recognized name; now it has become a synonym, with many other old friends. The author even explains that his own revised nomenclature of the family, which was used so recently as 1931, "as far as it was ready in manuscript," has had to be revised at the last moment after consulting some more papers on the subject. As he well says, the nomenclature of the genus is very confused. He traces the history of the various generic names applied since Montfort (1808), and finally (let us hope) decides that *Fasciolites* Parkinson (1811) must stand; *Clausulus* Montfort (1808) must become *Nealveolina* Silvestri (1928); and *Alveolina* d'Orbigny (1826) must become *Alveolinella* Schubert (1910). A chapter, illustrated with text-figures, is devoted to structural details. Further chapters deal with the species identifiable in the East Indies, their localities and stratigraphical distribution, and the bibliography of the group. The plates are reproduced from photographed sections and are quite good. A. E.

Ultramicroscopic Viruses.

Intranuclear Inclusions in Monkeys.—W. P. COVELL ("The Occurrence of Intranuclear Inclusions in Monkeys, Unaccompanied by Specific Signs of Disease," *Amer. Journ. Path.*, 1932, 8, 151-8, 1 pl.). Acidophilic intranuclear inclusions are described in the cells lining the bile ducts of the liver, the lining cells of the trachea and bronchioles, and in the alveolar epithelium of the lungs of rhesus monkeys. The existence of a filterable virus is postulated. G. M. F.

Intranuclear and Cytoplasmic Inclusions ("Protozoan-like Bodies") in the Salivary Glands and Other Organs of Infants.—S. FARBER and S. B. WOLBACH (*Amer. Journ. Path.*, 1932, 8, 123-36, 2 pls.). In the submaxillary glands removed in a series of 183 post-mortem examinations on infants, large cells containing intranuclear and cytoplasmic inclusion bodies ("protozoan-like bodies") were found in twenty-two cases. The inclusions were always seen in the duct cells and usually in the immediate vicinity of the inclusion-laden ducts there was dilatation of the ducts and areas of lymphoid infiltration. In two older cases inclusions were seen in the parotid and submaxillary glands, and in two instances in epithelial-lined spaces of the liver, lungs, kidneys, pancreas, and thyroid, thus adding twenty-six new cases to the twenty-five already in the literature. All the patients in this series were less than 17 months of age, the majority being under 1 year. The cytoplasm of cells with inclusions was basophilic in staining reaction and usually contained a varying number of dense basophilic oval or rounded granules. Clinical and pathological studies of the series reported revealed no association with any distinctive feature or group of symptoms or disease changes. The frequency of the inclusions in this series suggests geographical factors affecting their occurrence and leads to the suspicion of the existence of a disease in infants of filterable virus aetiology. G. M. F.

Manchurian Typhus and *Rickettsia manchuriae*.—M. KODAMA, G. TAKAHASHI, M. KOHNO, and Y. FUTAKI ("Natural Hosts and Disseminators of *Rickettsia manchuriae* (a Preliminary Note)," *Kitasato Arch. Exp. Med.*, 1932, 9, 84-9). Sporadic typhus fever of an aberrant type occurs in Manchuria and is believed by the writers to be caused by a form of *Rickettsia* differing slightly from *R. prowazeki*. *Xenopsylla cheopis* is believed to transmit the disease. G. M. F.

Yellow Fever Encephalitis in Monkeys.—E. W. GOODPASTURE ("Yellow Fever Encephalitis of the Monkey (*Macacus rhesus*)," *Amer. Journ. Path.*, 1932, 8, 137-50, 3 pls.). Intracerebral inoculation in monkeys of a mouse strain of yellow fever virus produces an acute disseminated encephalomyelitis, extending apparently throughout the central nervous system, affecting the cellular tissues, and causing necrosis of ganglion cells, both sensory and motor. Intranuclear inclusions sometimes resembling, but more often differing from, those characteristic of yellow fever have been demonstrated in ganglion cells of the encephalitic monkey's brain. On immunological and histological grounds it is judged that the virus of mouse and monkey encephalitis represents a biologically modified strain of yellow fever virus. Cytologically the evidence of morphologically characteristic yellow fever intranuclear inclusions in the brain of encephalitic monkeys inoculated with the mouse virus is inconclusive. G. M. F.

Experimental Transmission to the Monkey of a Diffuse Encephalomyelitis of Human Origin.—C. JONESCO-MIHAILESTI, D. NOICA, and B. WISNER. ("Transmission expérimentale au singe d'une encéphalo-myélite disséminée

humaine," *Compt. rend. de l'Acad. des Sci.*, 1932, **194**, 1028-9). Brain emulsion and cerebro-spinal fluid, bacteriologically sterile, obtained from fatal cases of encephalomyelitis produced in *Macacus cynomolgus*, when inoculated intracerebrally, a fatal disease characterized by paresis, sleepiness, and death. The condition was transmitted in series. Rhesus monkeys and baboons were insusceptible. G. M. F.

Histological Changes in Atypical Forms of Encephalomyelitis.—G. KAHLMEYER ("Patho-anatomical Investigations of Cases of Encephalomyelitis disseminata acuta (neuraxitis focalis acuta) probably belonging to Morbus Economo," *Acta med. Scand.*, 1931, **77**, 171-86, 5 text-figs.). Besides the more typical forms of encephalitis lethargica with mesencephalic symptoms there have in recent years been described many cases with symptoms referable to the pons, medulla oblongata, and upper part of the cervical cord. In three cases with such symptoms the histological changes varied from faintly marked inflammatory processes of the nerve tissue with slight lymphocytic infiltration round the vessels and proliferative glia reaction, to hæmorrhage and necrotic foci with secondary degeneration, invasion of fat granules in the nerve tissue and intensive perivascular infiltration with lymphocytes and plasma cells. The ætiological relationship of these cases to classical encephalitis lethargica and to so-called acute sclerosis "en plaques" is discussed. G. M. F.

Attempts to Cultivate the Virus of Foot and Mouth Disease in the Brain of Guinea-pigs.—M. GALEA ("Essai de culture du virus aphteux dans l'encéphale du cobaye," *Compt. rend. Soc. de Biol.*, 1932, **109**, 19-21). Experiments were made by injecting into the brains of guinea-pigs a strain of foot and mouth virus intermediate between the O and A types of Vallée. The virus was not capable of multiplying in the normal or damaged central nervous system of guinea-pigs, but at once invaded the whole organism without causing any definite nervous symptoms. G. M. F.

The Organism of Contagious Agalactia.—W. W. BYDGOSZ ("Agalaxie contagieuse des chèvres et des moutons," *Compt. rend. Soc. de Biol.*, 1932, **109**, 204). The organism of contagious agalactia of sheep and goats passed through Berkefeld N and Chambeland L₁ candles. Details are given of an elaborate life-cycle beginning with an oval or spherical spore, 0.3 μ in diameter, which becomes annular, while at one point a mycelial filament, 25 μ or more, grows out. The end of the filament forms a ring in which are produced one to eight granules (conidial ring with exospores). The conidial granules again produce filaments, thus eventually giving rise to a network. The mycelial filaments also form granular masses (spermatocysts) from which escape tiny granules with delicate filaments (spermites). The name *Anulomyces agalaxiae* is given to the organism. G. M. F.

Dog Warts.—W. A. DE MONBREUN and E. W. GOODPASTURE ("Infectious Oral Papillomatosis of Dogs," *Amer. Journ. Path.*, 1932, **8**, 43-55, 2 pls.). The results obtained with the virus of dog warts confirm those obtained by Findlay ("A System of Bacteriology," 1930, **7**, 252). Basophilic intranuclear bodies, similar to those found in human warts, occurred in a few of the large wart-cells of the older lesions. G. M. F.

The Effect of Vaccinia Virus on the Lungs in Rabbits.—R. S. MUCKENFUSS, H. A. MCCORDOCK, and J. S. HARTER ("A Study of Vaccine-virus Pneumonia

in Rabbits," *Amer. Journ. Path.*, 1932, 8, 63-72, 4 pls.). A characteristic form of pneumonia can be produced in rabbits by the introduction of vaccine virus into the lungs. The alveoli first contain coagulated albuminous fluid and fibrin, and later a cellular exudate composed principally of large mononuclear cells. Necrosis of the exudate and of the alveolar walls leads to hæmorrhage and to the appearance of polymorphonuclear leucocytes. The perivascular lymphatics are distended with coagulated fluid, while the walls of many of the larger blood-vessels are cedematous and often show a diffuse infiltration of all the coats with polymorphonuclear leucocytes. Guarnieri bodies have been demonstrated in the epithelial cells of the bronchi in four animals.

G. M. F.

BOTANY.

(Under the direction of A. B. RENDLE, D.Sc., F.R.S.)

GENERAL.

Cytology.

Linkage in Maize.—E. W. LINDSTROM ("Linkage of Qualitative and Quantitative Genes in Maize," *Amer. Nat.*, 1929, 63, 317-27). Ten varieties of maize were used in this investigation and the following conclusions reached. Number of rows in the maize ear, a typical quantitative character, is associated in inheritance with such simple qualitative characters as cob, aleurone, and endosperm colour as well as endosperm texture (sugary). The experimental evidence for genetic linkage between some of the multiple genes for row number and the genes for cob (and pericarp) colour, endosperm colour (*Yy*), and endosperm texture (*Su su*) is particularly convincing in certain crosses. That for aleurone colour, especially the *Rr* genes, is extremely suggestive of a linkage. Accordingly it is highly probable that genes for row number are localized on the third (sugary), fifth (*Yy* endosperm colour), and sixth (cob and pericarp) chromosomes; and very likely on the second chromosome (*R*-aleurone) as well.

J. L.

Male Sterility in Zea Mays.—M. M. RHOADES ("Cytoplasmic Inheritance of Male Sterility in *Zea Mays*," *Science*, 1931, 73, 340-1). Investigations of a male sterile line of maize from Peru indicate that the sterility is determined entirely by the non-nuclear elements of the maternal gamete. Cytological investigation shows the meiotic divisions in microsporogenesis to be normal. The degeneration of the pollen occurs usually after the first vegetative division.

J. L.

Cytology and Genetical Relationships in *Oenothera*.—R. E. CLELAND ("Cytological Evidence of Genetical Relationships in *Oenothera*," *Amer. Journ. Bot.*, 1931, 18, 629-40). Data are summarized which point to the existence of the following three correlations between chromosome behaviour on the one hand and genetic relationship between complexes on the other. (1) Plants with identical genetic make-up have in general identical chromosome configurations in diakinesis. (2) Complexes are known which, although residing in different races, are nevertheless essentially identical genetically, or closely related. When essentially identical, such complexes give identical chromosome configurations when combined with a given third complex. When closely related, they give similar configurations when so combined. (3) Complexes which are closely related genetically yield, when combined with each other, configurations with most or all of the chromosomes paired. Those which are more distantly related give configurations in which more of the chromosomes are involved in circles. These correlations are probably to be explained on the basis of the segmental interchange theory.

J. L.

Chiasma Analyses in Polyploids.—E. W. ERLANSON ("Chromosome Organization in *Rosa*," *Cytologia*, 1931, 2, 256-81). Anthers and root-tip material

from the rose "Orleans," *Rosa blanda* and *R. relictæ*, were studied cytologically to discover whether chromosome behaviour within the species was in agreement with the chiasma theory of chromosome pairing. Camera lucida drawings (magnification up to 9000) made during diakinesis reveal chiasmata. Somatic chromosomes showed constrictions varying in length from about 1.5μ to 3μ . Pairing was found to be by chiasmata. Chiasma-frequency was analysed in pollen mother-cells of two diploid roses, and frequency polygons are given. Metaphase complements from the rose "Orleans" are given. The effect of terminalization was apparent in the regular falling off of the mean number of chiasmata per potential bivalent, and in the reduction in the proportion of interstitial to terminal chiasmata from early diakinesis to metaphase. Quadrivalent configurations are recorded during diakinesis in the diploid roses. *Rosa blanda* showed in addition a few sexvalents; an interpretation of the quadrivalents on the basis of segmental interchange in conjunction with parasynapsis is given. *Rosa relictæ* was shown to be a sterile tetraploid with a mean chiasma-frequency of 1.71 per potential bivalent, and also a structural hybrid. Theories maintained by Hurst are shown to be untenable by direct cytological observation, and an alternative hypothesis is given to account for the unbalanced polyploid species, which does not involve a hypothetical decaploid ancestral form.

J. L.

Chromosomes of the Pomoideæ.—A. A. MOFFETT ("The Chromosome Constitution of the Pomoideæ," *Proc. Roy. Soc.*, B, 108, 1931, 423–46). The basic chromosome number in the Pomoideæ is 17. All the species and varieties examined were orthoploid, having 34, 51, or 68 chromosomes. A particular long type of chromosome is represented four times in the diploid, six and eight times in the triploid and tetraploid respectively. Secondary pairing occurs amongst the chromosomes of all the diploid types, forming sexvalent and quadrivalent groups. In extreme cases seven groups are formed, three sexvalents and four quadrivalents. Multivalent associations occur less frequently. There are two types of triploids: (i) Auto-triploids: these usually form trivalents, but higher associations have been observed, showing that autosyndesis takes place within each of the supposed haploid complements. Divisions are slightly irregular. (ii) Allo-triploids: formed from a cross between a diploid and a tetraploid, and having very irregular divisions. Tetraploid forms show secondary pairing, groups of six and eight being most frequent. Seedlings of triploid \times diploid apples most frequently had chromosome numbers of $2n + 7$. In triploids intercrossed or selfed the seedlings showed a higher chromosome number than would be expected. Chromosome pairing, chromosome morphology, and breeding results indicate that, as in *Pyrus*, the 34 chromosomes of the diploid Pomoideæ are of seven types, of which four are represented four times and three are represented six times. The number 17 is therefore a secondary basic number and the derived series of polyploids are secondary polyploids. It is suggested that the Pomoideæ owe their special morphological character to their state of secondary balance. Change of balance is a factor in evolutionary change.

J. L.

Chromosomes of *Lathyrus tuberosus*.—E. L. FISK ("The Chromosomes of *Lathyrus tuberosus*," *Proc. Nat. Acad. Sci.*, 1931, 17, 511–13). The haploid chromosome number in *Lathyrus tuberosus* is 7, thus agreeing with other species of *Lathyrus*. Stages of diakinesis, heterotypic and homotypic metaphase were studied. The chromosomes are comparatively large, showing variation in size and shape, and some indication of spiral structure. Microspore formation takes place by furrowing of the plasma membrane. Drawings are given of stages in the

division of the microspore nucleus, during which haploid counts could be obtained. The author also confirms Winge's count of 7 as the haploid number for *L. latifolius*. J. L.

Abnormal Chromosomes of *Gasteria*.—HSU-CHUAN TUAN ("Unusual Aspects of Meiotic and Postmeiotic Chromosomes of *Gasteria*," *Bot. Gaz.*, 1931, 92, 45-65). The normal behaviour of meiotic chromosomes of *Gasteria* as described by Taylor is summarized. Three types of abnormal meiotic and postmeiotic chromosomes are described. The chromosomes of the second metaphase may be of a type exactly similar to the first metaphase chromosomes. They are directly derived from the heterotypic chromosomes by omission of interphase and second prophase. Abnormal giant-headed chromosomes are derived from first metaphase chromosomes by partial disorganization at telophase. The third abnormal type is represented by heavily constricted chromosomes in binucleate cells. These are derived from first metaphase chromosomes through a short interphase period and dissolution of the nuclear membrane. These types show a single spiral structure through the omission of the first interphase and second prophase. In some cases a third division of the chromosomes resulting in eight-celled groups of microspores was observed. A nucleolus was seen in nuclei with fully developed chromosomes; it was not converted into any of the chromosomal appendages. Observed polyspory and lagging chromosomes indicate that the material used may be from a hybrid species of *Gasteria*. This fact, and the possibility that physiological factors are involved are suggested as responsible for the abnormal behaviour of chromosomes recorded. J. L.

Chromosome Circles in *Oenothera*.—R. CLELAND and A. F. BLAKESLEE ("Segmental Interchange, the Basis of Chromosomal Attachments in *Oenothera*," *Cytologia*, 1931, 2, 175-233). The mutual interchange of parts of non-homologous chromosomes is considered to be responsible for the formation of circles of chromosomes found during meiosis in *Oenothera*. The chief points from the study of twelve species are: there is no chromosome configuration possible to 14-chromosome species which cannot be formed in numerous ways by the proper arrangement of the ends of two sets or complexes of seven chromosomes and the union of these chromosomes in pairs. Complicated chromosome configurations can arise in nature by short series of simple segmental interchanges. Using facts known according to the authors' hypothesis it is possible to predict the exact arrangement of chromosomes in certain hybrids. Eight predictions were made and in five cases have agreed with facts. Detailed reasoning in all cases is given. Difficulties in the way of the hypothesis are discussed, and shown to be more apparent than real. The end-to-end union of chromosomes in *Oenothera* during meiosis is shown to be due to segmental interchange. J. L.

Cytology of *Matthiola incana* R. Br.—J. PHILP and C. L. HUSKINS ("The Cytology of *Matthiola incana* R. Br. especially in Relation to the Inheritance of Double Flowers," *Journ. Gen.*, 1931, 24, 359-404). Study of the somatic chromosomes shows that the ever-sporting races of *Matthiola incana* have a heteromorphic pair of chromosomes ("A"), one of the members having lost a trant. Pure singles and doubles have a full chromosome complement; "Crenate," a race trisomic for doubleness-singleness factors, has three "A" chromosomes, thus proving this chromosome to be the one concerned in the inheritance of doubleness. Variety "Snowflake" and its mutants have long meiotic chromosomes. All other races studied have short meiotic chromosomes. Pollen mother-cell meiosis in the short chromosome races shows various irregularities, including multiple associations

indicating segmental interchange and reduplication, but none have been directly correlated with the inheritance of doubleness. Similar irregularities occur in pollen mother-cells of long chromosome strains, but more frequently. Strong evidence in favour of Darlington's chiasma theory of metaphase pairing is obtained from trisomic strains. The mutation producing long chromosomes is correlated with other changes expected on Darlington's hypothesis, which seeks to explain the relationship of meiosis to mitosis. The trivalent deficiency in the "A" chromosome is regarded as being completely lethal to male gametes and incompletely to female gametes, thus giving the ever-sporting character to the single. The bearing of segmental interchange and reduplication is also considered. Expected proportions on this hypothesis provide a closer fit to the genetic observations than those based on previous hypotheses. J. L.

Macrogametophyte Development of *Lycopersicon*.—D. C. COOPER ("Macrosporogenesis and the Development of the Macrogametophyte of *Lycopersicon esculentum*," *Amer. Journ. Bot.*, 1931, 18, 739–48). The haploid number of chromosomes in the Bonny Best and Greater Baltimore varieties of *Lycopersicon esculentum* is 12. A list is given of chromosome counts so far obtained in cultivated varieties of tomato. The development of the ovule is described. With the appearance of the integument, a single hypodermal cell of the nucellus is differentiated as the archesporial cell and later functions as the macrospore mother-cell producing a linear row of four macrospores. The chalazal macrospore functions as the embryo-sac mother-cell, and a typical eight-nucleate embryo-sac is formed. The cells of the nucellus break down, and the inner layer of the integument is differentiated as a nutritive layer in contact with the embryo-sac. The embryo-sac becomes typically seven-celled, and each synergid has a distinct filiform apparatus. The pollen-tube enters the ovule through the micropyle and passes between the synergids, neither of which is destroyed during the process of fertilization. J. L.

Interspecific Hybridization in *Gossypium*.—S. NAKATOMI ("Hybridization between Old World and New World Cotton Species and the Chromosome Behaviour of the Pollen Mother-Cells in the F_1 Hybrid," *Jap. Journ. Bot.*, 1931, 5, 371–81). Interspecific hybridization between Old World cotton ($n = 13$) and New World cotton ($n = 26$) has been made. The varieties used in these experiments were Asiatic cotton (*G. herbaceum*) ($n = 13$), American cotton (*G. hirsutum*) ($n = 26$), Egyptian cotton (*G. barbadense*) ($n = 26$). When the Old World cotton was used as female parent, none of the resulting seeds germinated. A small number of seeds germinated, however, when either New World variety was used as female parent, i.e., the species with larger chromosome number. The F_1 hybrids were distinguished from both parents by increased vigour of growth of the stem, while other morphological features were intermediate. At heterotypic metaphase thirteen bivalent and thirteen univalent chromosomes were counted. At the first division the bivalents were divided and usually moved regularly to the poles. The univalents remained undivided and were irregularly distributed, some passing into the cytoplasm. In the second division the chromosome behaviour was very irregular, resulting in the production of abnormal tetrads. The F_1 plants proved completely sterile in (1) self-fertilization, (2) back-crosses, and (3) when fertilized with fertile pollen of other varieties. This perfect sterility depends on the formation of abortive germ cells. J. L.

Pollen Grains of *Dahlia*.—R. P. WODEHOUSE ("The Origin of the Six-Furrowed Configuration of *Dahlia* Pollen Grains," *Bull. Torrey Bot. Club*, 1931, 57, 371–80). *Dahlia* pollen grains are distinct from others of the Compositæ in pos-

sessing six germ-pores instead of the more usual three. Associated with this is the fact that the four nuclei of the homotypic division tend to lie in one plane, instead of in a tetrahedral arrangement, and the four nuclei are connected by four spindles instead of the more usual six. Quadripartition is by furrowing, ending by constriction across the four connecting spindles. Thus each daughter-cell has only two points of contact with other cells instead of the more usual three. The author discusses the fact that these two points determine the position of the six symmetrically placed furrows in the tetrahedral configuration. J. L.

The Nature of "Protoplasmic Connections."—V. JUNGERS ("Recherches sur les plasmodesmes chez les végétaux," *La Cellule*, 1931, 40, 8–81). The nature of "protoplasmic connections" between cells, according to previous investigators, is discussed at length, and the present work undertaken to observe the reactions obtained under different reagents in the following material: The endosperm of *Phoenix dactylifera*, *Chamaerops excelsa*, *Phytalephas macrocarpa*, *Iris Pseudacorus*, *Strychnos Nux-vomica*, and *S. potatorum*; Callus material of *Cucurbita Pepo* and *Vitis vinifera*; and parenchyma of the stems of *Viscum album* and bulb scales of *Allium Cepa*. Three main methods are used and the technique is described. Fifty-three drawings of cell walls with plasmodesma are included; the results of all observations are compared and discussed. Plasmodesma are not destroyed by the action of Eau de Javelle, but stain deeply after treatment. The author rejects the idea that plasmodesma are of a protoplasmic nature, and from present observations concludes that they are constituent elements in the structure of the cellular membrane. J. L.

Anatomy.

Micro-Technical Methods in Plant Anatomy.—J. KISSER, "Chemische, physikalische und physikalisch-chemische Methoden zur Untersuchung des Bodens und der Pflanze" (*Handbuch der biologischen Arbeitsmethoden*. Abt. XI, Teil 4, Heft 2, Lfg. 353, Urban & Schwarzenberg, Berlin and Vienna, 1931, 1–178, 20 figs., 3 pls.). This issue contains three articles on the Preparation of Plant-ash pictures and Silica skeletons from Anthrakogramms, the Preparation of Thin Sections of Recent Plant Material, and Maceration Methods applied to Recent Plant Material. Anthrakogramms are microscopic preparations of organic material produced by carbonizing to a certain stage. The application of the method lies in the comparison of normal plant tissues with charcoal. The second article summarizes methods of infiltrating and embedding plant material preparatory to cutting sections. The third describes in some detail methods of macerating plant tissues and includes separate sections on the treatment of living tissues without destroying the cell contents, algæ and fungi, parenchyma, latex tubes, sieve tubes and excretory cells, lignified tissue, bast fibres, cork, and methods of isolating individual tissues, such as epidermal layers and plant cuticles. B. J. R.

Standardization of Numerical Values used in Describing Woods.—M. M. CHATTAWAY ("Proposed Standards for Numerical Values used in Describing Woods," *Trop. Woods*, 1932, 29, 20–28). The value of the dimensions of wood elements for comparative and diagnostic purposes depends on the method of expression. Indefinite qualifications such as "moderately large" and "very numerous" are of little value unless they are based on some kind of standard. The author proposes a series of standard terms for describing the size and distribution of wood elements, based on actual measurements and devised so as to be in accord, so far as possible, with the classifications of other authors. B. J. R.

Diagnostic Value of Measurements in Wood Anatomy.—H. E. DESCH ("Significance of Numerical Values for Cell Dimensions," *Trop. Woods*, 1932, 29, 14–20, 1 fig.). Numerical values for the dimensions of wood elements are of little value unless qualified by particulars indicating their limitations. The Paper advocates the use of statistical methods in assessing the significance of numerical values in place of simple arithmetic averages for cell dimensions. B. J. R.

Anatomical Structure of a Dwarf Form of *Picea excelsa*.—J. KISSER and A. SESSER ("Biologische Untersuchungen an Zwergbäumchen. I. Die Strukturverhältnisse der Hochmoorformen von *Picea excelsa*," *Biol. Gen.*, 1931, 7, 13–68, 5 figs, 3 pls.). The structural characteristics of dwarf spruces growing on a typical high moor are described. The reduced development manifests itself in reduction of growth in length and thickness. The size of the needles as regards both length and thickness is about half normal, but their number is greater than normal. In spite of their age, about fifty years, the trees never bear cones. The dry weight of the needles is greater than normal; their ash content is decidedly less. The ash content of the wood is higher than normal. Comparative microscopic examination shows that the smaller size of the needles in the dwarf form is due to reduction in the number of cells, while in the wood there is a decrease in both the number and the size of the cells. The lumina of the tracheids are reduced more than the cell walls. Reduction in the size of the tracheids is accompanied by a reduction in the size of the bordered pits. The cavity of the resin ducts is about two-thirds the normal size; the number of resin ducts per unit area of cross-section is about the same as in spruce grown under normal conditions. Reduction in the number and size of the medullary rays was noted, the latter being due mainly to a decrease in the number of cells composing a ray. Reduction in the size of the phloem parenchyma cells is not reflected in the size of their nuclei, which are about normal. B. J. R.

Wood Structure of *Abies*.—E. G. WIESEHUEGEL ("Diagnostic Characteristics of the Xylem of the North American *Abies*," *Bot. Gaz.*, 1932, 93, (1), 55–70, 16 figs.). Eleven species and varieties of the genus were studied. The presence of bordered pits in the tangential walls of the summer-wood tracheids was found to be constant except in two species. Characters of diagnostic value within the genus are the thickness of the summer-wood tracheid walls, the number of rows of bordered pits on the radial walls of the tracheids, the width and maximum height of the rays, the shape of the ray cells and the number of rays per unit area, the presence of crystals in the ray cells and the colour of the heartwood (reddish in *A. nobilis* and *A. magnifica*, light-coloured in the other species). The presence of tangential lines of resin ducts is reported to be a regular feature of *A. venusta*. The diagnostic characteristics are summarized in tabular form and a key is given to the identification of the species. B. J. R.

Wood Structure of Some East African Coniferae and Leguminosae.—L. CHALK, J. BURTT DAVY, and H. E. DESCH ("Forest Trees and Timbers of the British Empire. I. Some East African Coniferae and Leguminosae," Clarendon Press, Oxford, 1932, 1–68, 12 figs., 10 pls.). This, the first issue of a new series combining systematic botanical descriptions with descriptions of wood structure, comprises the following species: *Juniperus procera* Hochst., *Widdringtonia Whytei* Rendle and *W. juniperoides* Endl., *Podocarpus gracilior* Pilger and *P. milanjiana* Rendle, *Afzelia quanzensis* Welw., *A. africana* Smith and *A. bipindensis* Harms, *Baikiaea plurijuga* Harms, *Copaifera mopane* Kirk, *C. coleosperma* Benth., *Piptadenia Buchananii* Baker and *P. africana* Hook. f., *Pterocarpus angolensis* DC. and

P. Stevensonii Burt Davy. The wood descriptions are in considerable detail; macroscopic features such as can be used for the field identification of timbers are given separately from the microscopic details. Care has been taken to ensure their accuracy by basing the descriptions on the examination of a wide range of authentic material in each case. They are illustrated by photomicrographs. B. J. R.

Wood Structure of *Gironniera*.—H. H. JANSSENIUS ("Note on the Wood of the Genus *Gironniera*," *Trop. Woods*, 1932, 29, 28–9). Examination of the wood structure of *Gironniera subæqualis* Planch. and *G. cuspidata* Kunz. of the Ulmaceæ leads to the conclusion that the two species cannot properly be included in the same genus. The wood of *G. subæqualis* closely resembles that of various species of *Parasponia* and *Trema*, while that of *G. cuspidata* shows no such relationship.

B. J. R.

Distinctive Features in the Anatomy of the Needles of *Picea pungens* Andre and *P. Engelmannii* Engelmann.—H. F. MARCO ("Needle Structure as an Aid in Distinguishing Colorado Blue Spruce from Engelmann Spruce," *Bot. Gaz.*, 92, 4, 447–9, 6 figs.). The anatomical features common to both these species in the structure of their needles are: (1) An epidermis; (2) A single layer of hypoderm which increases to several layers in the angles of the needle; (3) An endodermis of equal-sized cells; and (4) Two vascular bundles. The species can be distinguished from one another by the distribution in them of the "short" resin canals common to both species. From the upper half of the needle of Engelmann spruce resin canals are usually absent, whereas one or more are invariably present in the corresponding part of the needles of Colorado blue spruce. Resin canals were found in the lower part of the needle in both species. It was necessary to take serial sections of a number of needles in each species to ensure a correct identification.

C. R. M.

Anatomy of Normal and Acid-injured Cotton Roots.—U. R. GORE and J. J. TAUBENHAUS ("Anatomy of Normal and Acid-injured Cotton Roots," *Bot. Gaz.*, 92, 4, 436–41, 10 figs.). The roots of cotton become greatly swollen, and the bark becomes fissured longitudinally when the crop is grown on an acid soil. A description is given of the anatomy of roots that have been thus injured. The greater part of the normal root consists of secondary xylem, composed of scattered vessels with bordered pits and sometimes tyloses; ray cells; and fibres with tapering ends and bordered pits. The secondary phloem consists of alternating groups of sieve tubes and phloem fibres, and also wedge-shaped rays. Resin glands occur in the phloem. A periderm is formed by the activity of a phellogen situated in the pericycle. In acid soils (pH 3.0–4.0) it is stated that the original phloem becomes functionless, a cork cambium arises on the inside of the original phloem which gives rise to several layers of cork cells. The normal cambium then gives rise to a fresh phloem on the inside of the newly formed layer of cork. If the acid injury is severe the abnormal phloem consists chiefly of parenchyma cells, with but a few sieve tubes. Large masses of parenchyma are sometimes formed in the xylem when the injury is mild, but in more severe cases the cambium gives rise to an excessive quantity of xylem containing an unusually small amount of distorted vessels, with very much shortened segments.

C. R. M.

Anatomy of the Primary Axis of *Solanum Melongena*.—ALBERT F. THIEL ("Anatomy of the Primary Axis of *Solanum Melongena*," *Bot. Gaz.*, 92, 4, 407–19, 10 figs.). The material used in this investigation was the "Black Beauty" variety of the egg plant—*Solanum Melongena* L. var *depressum* Bailey. About

5 mm. from the growing point of the root the epidermis, cortex, and stele could be recognized. Two glands appear in the region of the pericycle before the protoxylem and protophloem are formed, and later on the protophloem groups arise opposite them. The glands subsequently disappear. The transition from the diarch, radial protostele of the root to the bicollateral bundles of the stem was studied in seedlings 5 days old. The change is completed in the bundles of the midrib of the cotyledons. The first stage in the transition is to be seen when the diarch xylem plate divides into two, and the two primary phloem groups into three each. The cells at the centre of the axis remain parenchymatous. At a higher level the metaxylem bifurcates, and two of the phloem groups pass towards the centre of the axis. The two double bundles formed from the halves of the original diarch stele form the vascular traces of the two cotyledons in the region of the cotyledonary plate. Several small primary phloem groups come to lie opposite the inner faces of the primary xylem elements, whilst the remaining four groups nearest the metaxylem eventually come to lie on the outside of the original protoxylem groups. In this way the bundles become bicollateral. The foliar traces of the first internode are completely endarch.

C. R. M.

Anatomy of *Pisum sativum*.—JOSEPH H. GOURLEY ("Anatomy of the Transition Region of *Pisum sativum*," *Bot. Gaz.*, 92, 4, 367–83, 22 figs.). In passing from the root to the stem in *Pisum sativum* the vascular system is protostelic throughout part of the first internode, and the bundles remain exarch in the first and second internodes. The transition from root to stem is not, therefore, completed until the third internode. There is a transition from the triarch arrangement of the root at the cotyledonary node to one of six bundles in the first internode. "These consist of four elongated lateral bundles lying on either side of the small central pith and in the direction of the long axis of the elliptical stem." These four bundles are exarch, but in addition there are two small bundles which lie at the ends of the lateral groups and pass out to supply the first two alternate leaf bracts. The lateral bundles partly supply the leaf-traces of the fourth and fifth nodes. The first leaf-trace diverges from the stele at the second node, after which the lateral bundles approach one another more and more closely, thus forming endarch bundles above the leaf gap. Two bundles on the opposite side of the stem remain exarch in the second internode, but these change over at the third internode in the same way as described for the first two lateral bundles at the second internode. Thus, all the bundles in the third internode have assumed the endarch structure typical of the stem. There are four cortical bundles. Two of these, which are fibrous only, are situated opposite the leaf-traces, whilst there are fibrovascular ones opposite each lateral bundle. The fibrous bundles pass into the leaf, whilst the fibrovascular ones are the stipular traces. The rudimentary stipules at the second and third nodes are supplied by branches from the cortical fibrovascular bundles, whilst the bundles themselves end in the first true stipules at the fourth node. Bundles at right angles to the leaf-traces pass out from the stele in each succeeding node (starting with the second) and supply the leaves at the next node above.

C. R. M.

Physiology and Anatomy of Tracheæ.—RAM C. MALHOTRA ("A Contribution to the Physiology and Anatomy of Tracheæ, with Special Reference to Fruit Trees. I. The Influence of Tracheæ and Leaves on the Water Conductivity," *Ann. Bot.*, 45, 593–620, 8 figs.). The length, number, and distribution of the vessels in cut shoots (1 to 3 years old) obtained from trees bearing nuts, pomes, drupes, or citrus fruits were determined by (a) forcing mercury into the

bases of the cut shoots and counting the number of mercury drops present in transverse sections taken at successive levels above the base; (b) forcing nitrogen into the bases of the cut shoots and observing the number of points at which the gas escaped from transverse cuts at different levels. The same result was obtained when both methods were applied to the same shoot. The area of the cross-section of tracheæ and wood in cut shoots of apple and prune, and the number and area of the leaves on every 15 cm. were determined as follows: Immediately after cutting, the leaves were removed, and blue prints made to show their distribution on every 15 cm. of stem. The total water conductivity of 15 cm. pieces was determined by the methods used by Farmer ("Proc. Roy. Soc. London," B. 90, 218-32) and Holmes ("Ann. Bot.," 32, 553-67). Sections were cut at intervals and the lumina of the tracheæ in selected areas outlined on squared paper. The areas thus outlined were measured by means of a planimeter, as well as by checking them with the millimetre squares on the paper. The areas determined by the planimeter and on the squared paper agreed closely with one another. The age of the wood chiefly concerned with conduction was determined by growing 4-year-old willow trees (with their roots damaged as little as possible) for 90 hours in cans containing a 0.5-p.c. solution of congo red. The trees were then divided longitudinally, and transverse sections of one half taken at intervals. The other half was cut into lengths of 1 foot, each of which was cut longitudinally with a razor into strips. The sections were then rendered transparent by passing them through a series of alcohols with progressively higher concentrations from 20-95, followed by xylol, and finally dipping them in cedar-wood oil. "The sections were so transparent that the path of conduction of the dye used could be accurately followed without the use of a microscope." By the use of these experimental methods the following facts have been established. A correlation exists between the maximum length of a shoot, and that of the tracheæ. The maximum length of the tracheæ varies greatly in different trees, but in those bearing the same type of fruit (e.g., drupes, pomes, or nuts) they fall into well-defined length groups. (This was not true of *Vitis vinifera* and *V. labnestia*.) There is a correlation between the number of tracheæ in a cross-section at a given level and the diameter of the shoot at that level. "Apple shoots have more total wood and tracheæ area than prune below 15 cm. from the apex; but the percentage of the total wood area occupied by the lumina of the tracheæ at these points is greater in prune than in apple." The pith area increases in cross-section of apple and prune shoots from above downwards. The lumina of the tracheæ of prune wood occupy 50.2 p.c. of the total area of wood, whilst in the apple the percentage is 28.7. The area of the lumina of the tracheæ is thought to be of more importance than their number in determining how much water is conducted. "Theoretically it is shown from the data that a unit area of the lumina of the tracheæ in prune wood is 49 p.c. more efficient in conducting water than a similar unit area of the tracheæ in apple wood, assuming that the liquid to be carried in both kinds of wood has the same viscosity, and that other environmental conditions are identical." Water and dyes are transported most rapidly in the last formed willow wood.

C. R. M.

Physiology and Anatomy of Tracheæ II.—RAM C. MALHOTRA ("A Contribution to the Physiology and Anatomy of Tracheæ with Special Reference to Fruit Trees. II. Water Conductivity in Higher Plants and its Relation to Tracheæ," *Ann. Bot.*, 46, 181, 11-28, 1 fig.). The greater part of the subject matter of this Paper, which is a continuation of the one noted above, is physiological. The author describes experiments intended to determine the causes of the greater conducting efficiency of prune wood in comparison with that of apple.

The sap extracted from the tracheæ of prune appeared to have a greater density and viscosity, and to contain more sugars, proteins, and ash than that extracted from apple wood. It was shown, by means of a special apparatus, details of which are given, that: (1) The nature of prune sap itself was such that it offered 15.6 p.c. more resistance to being transported than did apple sap; (2) The walls of the tracheæ of prune afforded 10.75 p.c. more resistance to the flow of either prune or apple sap than did the walls of apple tracheæ.

C. R. M.

The Production of Pneumatophores and Aerenchyma by *Viminaria denudata*.—LILIAN FRASER ("The Reaction of *Viminaria denudata* to Increased Water Content of the Soil," *Proc. Linnean Soc., N.S.W.*, 56, 5, 391-406, 18 figs., 1 pl.). *Viminaria denudata* Sm. grows normally under mesophytic conditions, but in some places in a waterlogged soil, or where the ground is liable to be flooded, where certain branches of the roots grow upwards above the ground and serve as pneumatophores, in much the same way as is characteristic of some of the Mangroves. At other times a horizontal root turns and grows upwards above the ground, and, having formed an arch, penetrates the soil again and resumes its normal course. This type of arrangement recalls the "knee" type of "breathing-root" found in some of the Mangroves. Submerged roots also react to their environment by forming a secondary aerating system of parenchyma cells with abundant intercellular spaces. This aerenchyma arises from a phellogen situated in the pericycle. Bacterial nodules, which are sometimes present on the roots, also become invested with aerenchyma. This may happen (1) by the activity of a phellogen which arises around the developing nodule; (2) by the secondary cortex being pushed up so as to form a collar around the nodule; in this case the aerenchyma surrounding the nodule is a product of the normal phellogen of the root. Sometimes there are rings of cork situated at intervals in the secondary tissue of the aerenchyma. These are thought to arise from the phellogen when the soil on which the root is growing is temporarily less saturated with water.

C. R. M.

The Mycorrhiza, Latex System, and General Biology of *Lobelia gibbosa* Labill. and *L. dentata* Cav.—LILIAN FRASER ("An Investigation of *Lobelia gibbosa* and *Lobelia dentata*. I. Mycorrhiza, Latex System, and General Biology," *Proc. Linnean Soc., N.S.W.*, 56, 5, 497-525, 43 figs.). Both *Lobelia gibbosa* Labill. and *L. dentata* Cav. are annuals which grow in Australia, but whereas the former species is widely distributed the latter is confined to the coast and neighbouring highlands of New South Wales and part of Queensland. *L. gibbosa* is remarkable for the fact that when it flowers the underground organs and basal part of the shoot system are dead or moribund, and the plant is thought to live on food reserves in the stem. Young plants of *L. dentata* were found to have a well-developed underground stem with a wide cortex containing food reserves. Later on, however, the food reserves of the cortex are carried away in the latex vessels and the cortex shrinks. It is thought that a fungus infects the seedlings of both species, which are entirely subterranean. If the fungus is absent germination is stated to be unsuccessful. Fungal hyphæ are present in the seedling stage on the surface of the hypocotyl, where they penetrate the epidermis, and also between the cells of the cortex. Hyphæ are absent from the growing point of the root, but at successively older parts of the root three stages of fungal invasion are recognized. At first the hyphæ pass between the cells of the cortex, where they are evenly distributed, but sections taken farther from the apex reveal a definite fungal zone in the middle of the cortex. At this stage the enlarged hyphæ are filled with food

reserves. In sections of still older portions of the roots the food reserves are removed from the hyphae and become situated in the neighbouring cells of the cortex, whence they are subsequently removed to the latex system. Meanwhile the cells of the outer cortex become enlarged, and the fungus is crushed until only a few living threads remain in the outer cortex. The latex system in the roots and underground stem is confined to the phloem. It arises from rows of superimposed cells of which the intervening walls break down, so that the tubes are of the nature of vessels. In the aerial parts of the stem, branches of the latex system pass out between the cells of the endodermis and ramify amongst the cells of the cortex which contain chlorophyll. Latex vessels are also associated with the veins of the leaves, and the branches pass out into the mesophyll. There are also latex vessels present in all parts of the flower. Neither of the species will flourish in exposed situations. This is thought to be due to the inefficiency of the abnormal root system in times of drought, as compared with the normal root systems of other plants with which they have to compete. C. R. M.

The Leaf Buds of Angophoras.—GLADYS CAREY ("A Note on the Leaf Buds of Angophoras," *Proc. Linnæan Soc., N.S.W.*, 56, 5, 455-7, 4 figs.). In this paper the development of the leaf buds of *Angophora lanceolata* Cav. *A. subvelutina* F. M., *A. Bakeri* C. Hall, *A. intermedia* D.C., and *A. cordifolia* Cav. is described, and comparisons drawn between them. C. R. M.

Morphology.

Morphology and Anatomy of Sarcocaulon rigidum Schinz.—W. SCHMID ("Beiträge zur Kenntnis von *Sarcocaulon rigidum* Schinz," *Vierteljahrsschr. Naturforsch. Gesell. Zürich*, 1932, 77, 36-77, 48 figs., 1 photo.). *Sarcocaulon rigidum* Schinz is a small xerophytic shrub which, contrary to general opinion, is not a true succulent. Stem, branches, and root are covered with a compact mantle of resinous substance which gives the plant peculiar rigidity and protects it against excessive transpiration and against the rubbing effect of the shifting sands. This mantle is produced through the activity of a cork-cambium. The resin, which later on fills and agglutinates the collapsed cells of the periderm, is formed in the same region. Contrary to general opinion, the resin is not excreted. Two kinds of resin can be distinguished, of which one is probably produced at the beginning, the other at the end of a vegetative period. The resinous tubercles, which are worked into pearls by the Hottentots, are fragments of branches concreted in camp fires and later rolled in the sand by the wind. As regards the leaves, those of the long shoots and those of the short shoots must be distinguished. The former have long petioles and are opposite, while the latter have short petioles and are fasciculate. The lamina of both kinds is rather thick; it is folded along the midrib and covered with a layer of wax; the inner structure is bilateral-symmetric. The lamina separates from the petiole at a definite abscission-region which may be recognized by its darker colour caused by the large quantity of calcium oxalate which it contains. The petioles of the leaves of the long shoots develop into spines, but the latter do not continue to grow after the leaves have dropped off. They serve to protect the plant. A. W. E.

Morphology of Cataphylls and Foliage Leaves in the Black Hickory.—ADRIANCE S. FOSTER ("Investigations on the Morphology and Comparative History of Development of Foliar Organs. II. Cataphyll and Foliage Leaf Form and Organization in the Black Hickory (*Carya Buckleyi* var. *arkansana*)," *Amer. Journ. Bot.*, 1931, 18, 864-87, 3 figs., 4 pls.). The shoot system of *Carya Buckleyi*

var. *arkansana* is of the monopodial-racemose type ("pleuroblastic racemose" of Domin) with "long" and "spur" shoots. On both types of shoots cataphylls and foliage leaves alternate periodically, except when the shoot is terminated by the female inflorescence. Accessory buds are frequently found on long shoots associated with the main axillary buds. These appear to be "reserve" buds. The terminal buds of long shoots consist of nine to eleven cataphylls, five to eleven foliage leaves, and usually the primordia of the two outer cataphylls of the following season's terminal bud. On the spur shoots the terminal buds are characterized by a greater constancy in the numbers of cataphylls (nine) and foliage leaves (three to four). The two outermost cataphylls of the terminal bud consist of a winged basal portion surmounted by a prominent apical pointlet which is morphologically equivalent to a terminal leaflet. These are designated "upper transitional forms." The bud scales proper are vaginate in form with no laminar differentiation. The foliage leaves in the winter bud consist of a lamina of five to seven convolute-involute leaflets, a short petiole, and a broadened leaf base. During expansion of the terminal bud, the inner scales form a tubular structure enclosing the enlarging foliage leaves. Eventually the cataphylls reflex and fall away. During growth of the foliage leaves the petiole rapidly elongates, followed by acropetal expansion of the leaflets and development of the rachis. The adult foliage leaf possesses an imparipinnate lamina of three to seven leaflets, a petiole, and a thickened leaf base. Successive leaves frequently show progressive reduction in the number of pairs of lateral leaflets, from seven to five or three. The adult lower bud-scales are ovate-acute or ovate-obovate emarginate, while the upper scales vary greatly, common types being obovate, spatulate, linear-rhomboid, and linear. Certain cataphylls develop a terminal poorly differentiated laminar lobe. In both cataphylls and foliage leaves the node is trilacunar with a tripartite median trace. The vascular tissue is arranged in a "stele" in the petiole of the foliage leaf, whilst the venation of the cataphylls is palmate-dichotomous with a pinnately branching midrib appearing in the spatulate, linear-rhomboid, and linear scales. The conclusion is reached that the cataphylls here represent unit foliar organs with an extremely simple morphological organization, and Cook's interpretation of hickory cataphylls as "primitive sheaths" is rejected. The cataphyll is fundamentally an organ possessing an axial region flanked by two lateral wings. These wings are regarded as portions of a simple foliar organ and not as stipules. F. B.

The Influence of Certain Experimental Conditions on the Growth Processes in Vegetative Reproduction.—ANNEMARIE HARIG ("Untersuchungen über die Experimentelle Beeinflussbarkeit von Wachstumsvorgängen bei Vegetativer Fortpflanzung und Regeneration," *Planta*, 15, 1 and 2, 43-104, 13 figs.). An account of experiments conducted with leaves or whole plants of *Cardamine pratensis*, *Bryophyllum crenatum*, *Begonia Rex*, *Solanum Lycopersicum*, and the liverwort *Marchantia* and other plants, in order to investigate the effect of stimulation by experimental means on vegetative reproduction and regeneration. Leaves of *Cardamine pratensis* produced adventitious roots and shoots under certain conditions, when they were detached from the parent plant. The same thing happened when all the axillary buds were removed and the inflorescence cut off in the spring. Buds also developed from the leaves when the latter were immersed in water or when the entire plant was kept in a saturated atmosphere. In both instances the growth reactions were the same, and are to be regarded as modes of regeneration, in spite of the fact that they are not necessarily initiated by the detachment of a plant organ. The formation of similar adventitious buds was also induced by immersing the aerial parts of potted plants in a bath of water

kept at a constant temperature of 34–35° C. in the dark. The plants were immersed for a period of 8–12 hours. Plants treated with hydrocyanic acid gas, chloroform, dichlorethylene, or water vapour under bell jars, reacted in the same way. On the other hand, hydrogen sulphide was ineffective. Detached leaves of *Cardamine pratensis* and *Bryophyllum crenatum* put forth adventitious buds so rapidly that it was found impossible to stimulate further activity by any of the above means. Attached leaves of *Bryophyllum crenatum* produced adventitious buds after treatment with HCN, immersion in a hot-water bath, and possibly also after treatment with water vapour; on the other hand, treatment with ether or chloroform, or injections with glutathione gave negative results. Regeneration processes in isolated leaves of *Begonia Rex* were not hastened by stimulation methods. Radium rays inhibited the formation of adventitious growth in *Cardamine pratensis*, *Bryophyllum crenatum*, *Begonia Rex*, and *Marchantia*. Fragments of *Marchantia* thallus with undamaged apical growing points did not give rise to adventitious outgrowths when plasmolyzed with a cane-sugar solution or subjected to stimulation treatments. In the same way stimulation methods were also ineffective with tomato plants. The rate of growth of *Lupinus* roots was not increased by treatment with HCN or ether. The young cells in the tubers of kohlrabi were induced to divide more rapidly by treating them for a short period with ether. On the other hand, treatment with HCN, immersion in the hot-water bath, or placing plants in a vacuum did not hasten cell divisions. It is thought that these experiments with *Lupinus* and kohlrabi indicate that the stimulation of growth and regulation of development are chiefly due to changes in the living cell. There is a discussion concerning the importance of the age of a cell in determining whether a positive or negative result is obtained with stimulation methods. C. R. M.

Floral Morphology of the Fumarioideæ.—AGNES ARBER ("Studies in Floral Morphology. III. On the Fumarioideæ, with Special Reference to the Androecium," *New Phyt.*, 1931, 30, 317–54, 15 figs.). The floral structure of certain genera belonging to the sub-family Fumarioideæ of the Fumariaceæ is described and the morphological interpretations of the androecium are discussed. The androecium in the sub-family is curiously diadelphous in that each phalange possesses a median dithecal member whose filament is fused more or less with those of two flanking monothechal members. The vascular supply of a flower originates within the inflorescence axis as three bundles—a bract bundle and paired pedicel bundles, the latter lying in what is to be the lateral plane of the flower. In *Corydalis* and *Fumaria* these pedicel bundles retain their original orientation throughout. In *Dicentra spectabilis* the two original laterally placed pedicel masses become reoriented so that finally the pedicel is served with its two principal bundles in an anterior-posterior plane. It is suggested that this change is necessitated by the gaps produced by the outward passage of the bracteole bundles, *Fumaria* and *Corydalis* possessing no bracteoles. The structure of the raceme apices was studied in *Corydalis* and *Fumaria* and much variation was noted. In some cases the apical one or two flowers received supernumerary vascular tissue from additional axis bundles, the apex becoming therefore non-vascular. A type was also seen in which the raceme-axis terminated in a bract with or without its attendant pedicel. In *Corydalis nobilis* and *C. lutea* a pair of small sepals is present with a normal vascular supply, whereas in *C. bulbosa* they are much reduced and entirely non-vascular. In the stamen-spur of *Corydalis* and *Fumaria* the bundle dips into the spur and, doubling back, pursues its way into the filament. The phloem of the bundles is carried downwards beyond the xylem. Even in *Dicentra spectabilis*, which possesses no spur, an extra development of phloem is

found in the stamen bases which bulge into the bases of the lateral petals. A relationship is suggested between the extra phloem and nectar secretion. Non-functional stomata were seen in the inter-synangial groove of *Corydalis bulbosa*. A rudimentary replum was observed in some cases in the ovary. The gynæceum strands in *Dicentra spectabilis* are secondary structures arising from stamen strands. The various views regarding the morphological interpretation of the androecium in the sub-family are discussed at some length, and a modification of Celakovsky's theory is put forward by the author. In this the androecium consists of six stamens, two normal dithecial members, and four reduced monotheacial ones, the latter alternating with the two pairs of petals. The dithecial pair belong to the inner whorl, though they are intimately connected anatomically with the lateral petals and count as one whorl with them. Pressure in early developmental stages is suggested as a factor in producing the peculiar structure of the flower. F. B.

Floral Development in *Daucus Carota*.—H. A. BORTEWICK, MABEL PHILLIPS, and W. W. ROBBINS ("Floral Development in *Daucus Carota*," *Amer. Journ. Bot.*, 1931, 18, 784-96, 36 figs., 1 pl.). Carrot roots set in late December in California had umbel primordia already differentiated by March 1st. At this stage a well-developed top is produced and stem elongation has already commenced. The primordia of sepals, petals, and stamens are almost simultaneous in development, while the carpel primordia are the last floral structures to develop. A line separating the two carpels divides the flower so that on the side facing the axis of the umbellet there are two sepals, three petals, and two stamens, while on the opposite side are three sepals, two petals, and three stamens. The two carpels originate as two protuberances at opposite sides of a circular, almost flat mass of meristematic tissue. These become crescent-shaped and extending laterally and concurrently becoming more elevated meet along the mid-line where they turn inwards, the margins meeting at the centre. A partition separating two loculi is thus produced. Two ovule primordia develop from the inturned margin of each carpel, though, as a rule, only the lower ovule becomes functional. The flower opens irregularly and staminal dehiscence and falling of the stamens occurs before the stigma becomes receptive. Fertilization acts as a stimulus to petal fall, clipping of the stigmas before pollination resulting in the retention of the petals. F. B.

Abscission of Perianth in *Hedera Helix* and *Parthenocissus quinquefolia*.—H. SIGMOND ("Die Ablösung der Blütenhüllblätter bei *Hedera Helix* L. und *Parthenocissus quinquefolia* (L.) Planch. Untersuchungen über Trennungsgewebe II," *Beih. Bot. Centralbl.*, 1931, 48, 335-62, 3 figs.). The abscission of the perianth-segments of *Hedera Helix* L. and *Parthenocissus quinquefolia* (L.) Planch. is investigated. In the former the petals are united in the bud by a cuticular suture. During the opening of the flower the individual sutures are burst open; the perianth-segments broaden and later curl back to the pedicel. During the flowering period the petals fall, this exfoliation resulting from an abscission-tissue formed close above the point of union of the corolla with the ovary. The abscission-zone is two-layered, consisting of a layer of rounded cells and a layer of more elongated cells beneath it. The abscission-tissue originates at an early stage and can already be distinguished in half-grown flower-buds; its cells are rich in starch and oil. The processes preceding abscission are discussed from a general point of view and particularly the importance of the two layers of cells which are found to be of very general occurrence. In *Hedera Helix* the elongated cells increase in size through growth, while the rounded cells remain unaltered, the former tissue

thus causing pressure on the latter so that tension is set up at the point of junction. There is also an increase of turgor in the abscission-tissue which causes the rounding off of the abscission-cells and more particularly of the rounded cells of the upper layer rather than of the elongated cells of the lower layer. The pressure at the boundary of the two layers now overcomes the reduced cohesion of the rounded cells above and the petal is cast off. In *Parthenocissus quinquefolia* the abscission-tissue occurs at the junction of the petals with the axis and originates at an early stage, as in *Hedera*. The abscission-cells do not form two definite layers, however, but are mostly rounded, the marginal cells being rounder and smaller than the inner ones. The individual cells are particularly rich in starch, of which little remains after the abscission of the perianth-segments. There is again an increase of turgor in the abscission-cells, and the splitting starts from both sides in the more rounded marginal cells. No cell-growth was discovered. In general, it is stated that abscission-cells are at first rich in starch and oil and that these substances are converted into sugar giving increased osmotic pressure. In both the species investigated there was no visible alteration in the cell-walls and in particular no swelling of the middle lamellæ; but in certain circumstances there was evidence of some metamorphosis in the cell-wall. It is possible that the processes of storage followed by consumption of the stored materials may affect the condition of the walls of the abscission-tissue.

A. W. E.

Pollen-grain Structure in the Polygonaceæ.—R. P. WODEHOUSE ("Pollen-Grains in the Identification and Classification of Plants. VI. Polygonaceæ," *Amer. Journ. Bot.*, 1931, 18, 749-64, 1 fig., 1 pl.). A critical study of pollen sculpture in six genera and twenty-seven species of American indigenous and cultivated Polygonaceæ. It is shown that within the family the ordinary, heavy-walled tricolpate, or three-furrowed pollen-grain, may have given rise to the thin-walled type with very reduced grooving. The basic type of the family, and one associated with several entomophilous genera, is that seen in *Eriogonum*. The grain is thick-walled, ellipsoidal, and traversed almost from pole to pole by three furrows which function as harmomegathi, or expansion folds. In the middle of each furrow is a germ-pore, exposed only when the grain is moist. In *Polygonum allocarpum* the grain may be polycolpate, the furrows nearly always arranged in the trischistoclastic system of equal linear stresses. In some anemophilous members of the family, such as *Rumex*, the grains are thin-walled with narrow linear grooves. The germ-pores are small and weakly developed. There is an obvious tendency for the total disappearance of pores and furrows in the wind-pollinated genera. Some of the insect-pollinated genera, however, possess a thick exine with an elaborate system of anastomosing vertical ridges. This is accompanied by a loss of furrows and an increase of germ-pores. In *Polygonum chinense* the surface is completely alveolate, while the germ-pores are large and compensate to some extent for the impaired harmomegathic function of the furrows. In *Persicaria* the furrows are completely missing, but their loss is compensated for by the large number of pores, about thirty, each of which is enclosed by a lacuna. This is the culmination of the line of development in the family. A dichotomous key, based on pollen-grain characters, to the twenty-seven species is given with, in addition, detailed notes of each species.

F. B.

Self-incompatibility in Fertilization of *Brassica pekinensis*.—A. B. SROUT ("Pollen-tube behaviour in *Brassica pekinensis* with Reference to Self-incompatibility in Fertilization," *Amer. Journ. Bot.*, 1931, 18, 686-95, 1 pl., 2 figs.). An account of fertilization experiments and pollen-tube behaviour in *Brassica*

pekinensis in which self-incompatibility is strongly developed. A cyclic and synchronous development of mid-period self-fertility was observed while usually no seeds were produced by selfing at beginning and end of flowering period. Special methods of self-pollination, dissection, and differential staining are given. Self-incompatibility shows itself in (1) low percentage of pollen-germination, (2) coiling of pollen-tubes on stigma, (3) feeble growth of pollen-tubes in the style, (4) coiling of ends of pollen-tubes at various stages up to the ovule, (5) combinations of the foregoing reactions. Normal fertilization was found to be completed in 24 hours after pollination. Plants showing extreme cyclic change of incompatibility give well-defined gradations from complete self-incompatibility to maximum self-fruitfulness, after which follows a series of stages in the reverse order. The proportion of coiling of pollen-tubes on the stigmas was found to be directly related to the number of viable seeds produced. The removal of the stigmatic fluid by water was found to have no effect on incompatibility or otherwise in fertilization. The incompatibilities in *Brassica pekinensis* appear to conform to none of the three main types recognized by Correns. There seems to be an interplay of two or three distinct types of hereditary factors. Certain factors appear to be present for incompatibility and others which favour fertilization. The former clearly inhibit fertilization. They obstruct fertilization when there is similarity in genetic composition of pistils and pollen and when there is dissimilarity; fertilization occurs through the action of fundamental factors. F. B.

The Morphological Value of Carpels in the Angiosperms—V. GRÉGOIRE ("La valeur morphologique des carpelles dans les angiospermes," *Bull. Sci. Acad. Roy. Belg.*, 1931, 17, 1286-1302, 1 fig.). A preliminary note giving the author's conclusions; a detailed account is to be published later. The ontogeny of an angiospermous carpel is essentially different from the ontogeny of a leaf, the primordia, in each case, being radically different in type. The central portion of the floral axis is entirely divided up in the process of carpel-formation. If a portion of the receptacle should remain unused, as in *Aquilegia*, it is a mere remainder which was insufficient to form another carpel. In a vegetative cone, however, the leaves owe their origin to lateral primordia. The carpellary primordia appear as prolongations of the tissue of whole sectors of the receptacle, which never occurs with leaf-primordia in a vegetative cone, and the meristem of the floral cone is entirely different from that of the vegetative cone. It is concluded, therefore, that the angiospermous carpel is not homologous with a leaf, nor with a branch, but should be considered as an organ *sui generis* without homology among the vegetative organs of the plant. The supposed transformations of carpels into leaves belong to two classes: (1) Monstrous carpels, which can be recognized as such by the presence of rudimentary ovules and stigma, which keep the characteristic form of the carpel at the base and apex, and which only superficially resemble a leaf; (2) The carpels are replaced by real leaves which have not arisen from carpellary primordia. The vegetative cone which has produced the branch destined to terminate in a flower has kept its own constitution instead of forming the characteristic floral meristem, and has consequently continued to produce leaves. The angiospermous carpel is not homologous with the so-called carpel of *Cycas*, and the latter should be called an "ovuliferous scale." A. W. E.

Ovule Morphology of *Anogra pallida*.—DONALD A. JOHANSEN ("Studies on the Morphology of the Onagraceæ. VI. *Anogra pallida*," *Amer. Journ. Bot.*, 1931, 18, 854-63, 28 figs.). *Anogra pallida* is almost completely sterile and reproduces itself vegetatively by offshoots borne on the ends of subterranean stolons.

Within each loculus of the ovary the ovules are disposed in a vertical almost uniseriate manner, a character of definite taxonomic value. Supernumerary ovules are frequent. The development of the megagametophyte is typical of the Onagraceae. Meiosis is perfectly regular and in a normal diaphase all chromosomes exist as single homologous pairs. The haploid number of chromosomes is 7. The micropylar megaspore is always the functional one, the remaining three degenerating slowly. The synergidae have a well-developed filiform apparatus. Fertilization normally does not occur and no traces of pollen-tubes have been found. The pollen-grains seem incapable of germinating, the protoplast being small and shrunken. Instead of the embryo-sac degenerating a most unusual phenomenon occurs, the polar nucleus undergoing a process of "multipartitioning." This process is *amitotic*. It occurs, on the average, in about 20 p.c. of the total number of ovules in each ovary. The nucleolus initiates amitosis and the daughter nuclei produced by repeated fission do not vary greatly in size amongst themselves. This contrasts with the normal behaviour of fertilized polar nuclei in other Onagrad in which successive generations of endosperm nuclei progressively diminish in size. The available nourishment appears to be the factor controlling rate of amitosis. The largest number of amitotic nuclei in a well-nourished megagametophyte was 140. In shape these nuclei range from spheroid to ellipsoid. A few instances were found in which the synergidae nuclei initiated divisions of an amitotic nature, but their number in one embryo-sac never exceeded twenty. In no case out of 16,000 ovules examined microscopically were apomictic or abnormal embryonal structures encountered.

F. B.

The Morphology and Cytology of the Apple Fruit.—URSULA TETLEY ("The Morphology and Cytology of the Apple Fruit, with Special Reference to Bramley Seedling Variety," *Journ. Pom. and Hort. Sci.*, 9, 4, 278-97, 8 figs.). An account of the development of the fruit of the Bramley Seedling apple from the standpoints of morphology and cytology. The rate of increase in weight, cell size, and thickness of the cuticle are correlated with the weather conditions. During the period of investigation (1930) the weather was sunny from June 22nd to July 11th and from August 15th to September 5th; the temperature varied from 55° F. to 70° F. from June 12th till the end of September, except for a very hot period from August 26th to 30th. The average weight of the apples increased steadily until the end of September (except during two sunless periods). The maximum weight was reached at the normal time of picking, but the maximum cell size was reached about a month earlier. The amount of cuticle deposited on the epidermis increased steadily until the end of October, more cuticle being deposited on the green than on the red side in the earlier stages. At the end of June starch was present only in association with the chloroplasts, but storage starch was deposited until the end of July when a maximum was reached, after which there was a gradual decrease until the end of October. Growth takes place only in the tissues between the base of the style and the point where the vascular bundle from the stem begins to branch. An endodermis is present just below the base of the apple, but not within the apple itself. The cells of the epidermis are plastic and gradually become stretched tangentially during June, July, and August. A continuous cuticle is present over the surface of the epidermis except where it is interrupted by stomata and bases of hairs. The latter break off at an early stage in the development of the apple. The cuticle is deposited throughout the growing season, not only on the surface but also on the radial walls of the epidermal cells. Some apples had depressions in the cuticle which were bridged over by thin layers of cutin. In small apples which remained on the tree until the middle of November,

and in apples which had suffered through lack of potassium, fatty deposits were observed on the lower tangential walls of the epidermal cells. Lenticels were often formed by the transformation of stomata. Before this happened the walls of the guard cells became thickened, a brown substance was deposited in the substomatal cavities and the cells surrounding them, whilst the walls of these cells became suberized, and the dead cells thus formed were cut off from the living cells beneath them by the formation of cork. Lenticels were also formed in association with the bases of the hairs. Maceration experiments showed that the middle lamella of the cells of the apple flesh gradually lost some substance which resisted the action of the macerating fluids. Chloroplasts were found chiefly in the subepidermal cells which, after the apple had set, became stretched tangentially with much-thickened walls. It is suggested that the subepidermal cells may be the seat of fat metabolism. Starch grains were not formed in association with leucoplasts, but were deposited in vacuoles in the cytoplasm. In stored apples the middle lamella broke down gradually, and when the cells subsequently separated from one another no aggregation of pectin remained on the wall (unless the apples were suffering from low temperature internal breakdown). A very small increase in the amount of cuticle on the epidermis was noted in a few instances after the apples had been placed in store. Less cuticle was deposited in apples grown with insufficient potassium. The structure of the "eye" or calyx end of the apple was studied in detail, more especially because the fungus *Nectria galligena* enters the apples at this end and causes "eye-rot." The calyx-cup is lined with a cork layer, of which the thickness varies owing to the fact that its surface becomes extensively cracked. The cork layer continues beneath the stamens, but dies away at the base of the sepals where it gradually merges with the epidermis. A layer of cork was present across the style at a short distance above the place where it became free from the calyx-cup. The tube formed by the style, which penetrated into the core of the apple, was lined with hairs. "In Bramley's Seedling this tube may be open all the way down into the core, but is usually blocked in places owing to the interlocking and growing together of some of the surface cells; these become cemented together by a layer of suberin, which stains heavily with Sudan III."

C. R. M.

Embryology of the Liliaceæ.—R. SOUÈGES ("Recherches sur l'embryogénie des Liliacées," *Journ. Soc. Bot. Fr.*, 1931, 78, 662–81, 74 figs.). The embryology of *Anthericum ramosum* L., *Allium ursinum* L., and *Muscari comosum* L. has been examined in detail and the two former are dealt with in the present paper. In *Anthericum ramosum* the apical and basal cells resulting from the transverse segmentation of the oospore divide, the former by a vertical, the latter by a horizontal wall, to give a pro-embryonic tetrad composed of two juxtaposed upper elements and two superposed lower elements. An eight-celled pro-embryo composed of four cells arranged horizontally about the axis in a quadrant at the apex, a pair of juxtaposed cells beneath, and two cells placed one above the other at the base is then formed by a process of regularly orientated bipartition. Further divisions result in a sixteen-celled pro-embryo; the quadrant of four cells dividing horizontally to form two upper layers, each of four cells; the two juxtaposed cells forming a third circumaxial quadrant; the cell immediately beneath dividing by a perpendicular wall to give two juxtaposed cells; and the lowest cell dividing horizontally to give, once more, two cells, one above the other, at the base. This forms a structure of six layers of cells or "stories." The two upper stories form the cotyledon; the next forms the axis of the hypocotyl and the growing point of the stem; the next provides the growing point of the radicle and most of the

sheath; the lowest but one forms the rest of the sheath and part of the suspensor; and the lowest forms the rest of the suspensor. The internal differentiation of the tissues is very slow. The dermatogen is not clearly individualized until the moment when the embryo, now spherical, elongates to give rise to the cotyledon. The periblem and plerome can only be distinguished much later, after the separation of the cotyledon. In *Allium ursinum* the pro-embryonic tetrad is formed as in *Anthericum ramosum* and the destiny of its elements is the same, except that the lowest cell does not contribute towards forming a suspensor. The tetrad forms an eight-celled pro-embryo with the cells normally arranged in three stories, as in the tetrad; there being a four-celled quadrant at the apex, two juxtaposed cells in the median region, and two further juxtaposed cells at the base. The pro-embryo of sixteen cells is built up of four stories: an eight-celled story at the summit with elements separated by vertical or oblique walls; then a story composed of a quadrant of four circumaxial cells; and lastly two lower stories, each of two juxtaposed cells. The uppermost story of the pro-embryo forms the cotyledon; the next forms the hypocotyl and the growing point of the stem; the lowest but one gives rise to the growing point of the radicle; and the lowest forms the sheath. There is no suspensor. Internal differentiation is again rather slow. First the dermatogen and later the periblem and plerome can be distinguished when the pro-embryo begins to elongate. The embryology of *Allium ursinum* differs from that of *Anthericum ramosum*: by the arrangement of the elements in the eight-celled pro-embryo; by the method of segmentation of the quadrants and the constitution of the sixteen-celled pro-embryo; by the general configuration of the pro-embryo and the absence of a suspensor; and by the more distinct organization of the tip of the radicle.

A. W. E.

Embryology of the Liliaceæ.—V. BAMBACIONI-MEZZETTI ("Nuove ricerche sull'embriologia delle Gigliaceæ," *Annali di Bot.*, 1931, 19, 365–78, Pls. VIII–X). The embryology of *Lilium candidum* L., *L. bulbiferum* L., *Tulipa præcox* Ten., *T. silvestris* L., *T. silvestris* var. *grandiflora* Hy., and var. *australis* (Lk.) Fiori, has been investigated. In the first three species the female gametophyte develops, in the main, according to the *Euphorbia dulcis* type. In *T. præcox* the three megasporial nuclei which migrate to the chalazal end of the embryo-sac may divide independently without disintegration: this plant also presents the anomaly of polarization, in which the four megasporial nuclei may either all re-unite at the lower extremity of the sac, where, dividing independently, they give eight nuclei, or they may arrange themselves in one pair at the micropyle and one pair at the chalazal end, giving, after division, an upper and a lower tetrad. In neither instance was any augmentation of the chromosomes in the chalazal nuclei verified. Ovules occurred, however, in which were united at the chalazal end four different nuclei, provided with diverse chromosome equipment and derived from a $1 + 3$ disposition of the megasporial nuclei. Exceptionally in *Lilium candidum* and in *L. bulbiferum* four nuclei, two haploid and two triploid, can re-unite at the lower end of the sac. *L. candidum* also shows frequent anomalies such as heterotypic division, the presence of a pluricellular archesporium, the presence of two nucelli in one ovule, and the multiplication of the antipodals by amitotic division. In the various varieties of *T. silvestris* examined the female gametophyte develops according to the non-polarized type found by Guignard; in this species anomalies are found caused by the abnormal formation of vacuoles. Intra-nuclear fusions are frequent during the mitotic divisions of the embryo-sac. In *Tulipa silvestris* there is an acceleration in development by the direct formation in three divisions of an eight-nucleate gametophyte.

A. W. E.

Embryology of *Sagittaria sagittifolia* L.—R. SOUÈGES ("L'embryon chez le *Sagittaria sagittifolia* L.—Le cône végétatif de la tige et l'extrémité racinaire chez les monocotylédones," *Ann. Sci. Nat. Bot.*, 1931, Sér. x, 13, 353-402, 109 figs.). In *Sagittaria sagittifolia* L. the pro-embryonic tetrad is formed from the apical cell of the bicellular pro-embryo, the basal cell forming a vesicle which has the usual rôle of giant cells. The two upper juxtaposed cells of the tetrad form the cotyledon; the median cell gives rise to the upper part of the axis of the hypocotyl and the growing point of the stem; while the lowest cell forms the lower half of the axis of the hypocotyl, the initials of the cortex, the sheath, and the suspensor. The formation of the sixteen-celled pro-embryo from the tetrad is described in detail, the account differing in certain fundamental respects from those of Hanstein and Fleischer, and a complete account is given of the development of the vegetative cone of the stem and the tip of the radicle, the latter agreeing with *Alisma Plantago*. If the embryo of the Alismaceæ is taken as typical for the Monocotyledons it must not be forgotten that this is due to the facility with which it can be studied, the regularity of the segmentations, and a number of accessory circumstances. This embryo doubtless possesses many general characters, such as those depending on the differentiation of the sheath and the single cotyledon; but it shows other characters which are not typical of the class as a whole. The precocious differentiation of the basal cell of the bicellular pro-embryo and the substitution of the apical cell for the egg-cell itself in the construction of the embryo are peculiar phenomena which are far from characteristic of the Monocotyledons in general. They are particularly frequent in hydrophytes (e.g., *Elodea canadensis*, *Potamogeton natans* and *P. lucens*, and *Najas marina*), but with numerous exceptions. This very precocious differentiation of the basal cell precludes any consideration of the embryo of the Alismaceæ as primitive. Embryos of primitive character show a more tardy and less accentuated differentiation; their pro-embryos are formed of similar cells which retain for a long time equal potentialities and which are arranged without apparent order or according to rules difficult to determine. Such primitive embryos are to be found both in the Dicotyledons and the Monocotyledons (e.g., in *Pistia*, many other Araceæ, and in some Orchidaceæ). Among the Liliaceæ and other important families the cells derived from the egg appear to possess equal powers of division and the tetrahedric arrangement is similar to that of most Dicotyledons, while the eight- and sixteen-celled stages are also common to the two classes of Angiosperms. There is, for example, the closest analogy between the development of *Muscari comosum* and certain Compositæ. It appears evident that the pro-embryo, defined as the embryonic body before the transition from axial to bilateral symmetry, is common to the Monocotyledons and to the Dicotyledons, differences only appearing when the change of symmetry takes place.

A. W. E.

Teratological Phenomena in *Saxifraga*.—A. M. JOHNSON ("Studies in *Saxifraga*. II. Teratological Phenomena in certain North American Species of *Saxifraga*," *Amer. Journ. Bot.*, 1931, 18, 797-802, 2 pls.). A study of the North American species of the sections Hydaticea, Dermasea, Tricarpum, Arabisa, and Micranthes in which a marked frequency of occurrence of floral abnormalities was observed. It was found that these malformations were most frequent in certain species-aggregates of special taxonomic difficulty, e.g., the *S. saxmontana*, *S. fragosa*, and *S. nidifica* complexes. Frequent teratological features were irregularities in shape, fasciation, and coalescence of the floral parts *inter se*, petaloidy of stamens and sepals, abortion of stamens in whole or in part, and of the carpels. A number of cases arose of open carpels suggesting phyllody, a few cases of supernumerary

carpels, and one case of complete suppression of the carpels, the more or less aborted ovules being exposed on a discoid surface. While not easy to explain, these abnormalities may possibly be due to hybridization. F. B.

Cleistogamy in *Cardamine chenopodifolia*.—TADEUSZ GORCZYNSKI ("Dalsze badania nad Kleistogamją. II. *Cardamine chenopodifolia* Pers.," *Act. Soc. Bot. Polon.*, 1930, 7, 295-309, Tabs. XX-XXI, 5 figs.). In *Cardamine chenopodifolia* there are two kinds of cleistogamous flowers: the one borne on aerial and the other on subterranean stems. The fruits of both are siliquas, but the subterranean are small and reduced. In the young stages of development the normal structure of the anther-walls is apparent in both kinds of flowers. In later stages one observes: (a) in the anthers of the aerial flowers, firstly the formation and secondly the arrest in development of the endothecium; (b) in the anthers of the subterranean flowers the arrest in development of the mechanical tissue and in later stages the degeneration of the walls. The tapetal layer forms neither symplastids nor periplasmodium; it is formed of secretory elements and degenerates *in situ*. The embryo-sac contains eight nuclei and the oosphere is fertilized by the generative elements from the pollen-tube. The embryo develops from the fertilized egg-cell and forms a suspensor composed of several cells (up to eight). The seeds in the two kinds of flowers are very similar although the fruits show considerable differences of structure. The siliquas of the aerial flowers form many seeds (ten to eighteen), while the subterranean fruits have only two. The anatomical structure of the large siliquas is remarkable for the single layer of mechanical tissue with thickened membranes which are lignified only on the inner side. This layer serves to make the fruit dehisce, while the small siliquas have irregular mechanical tissue in several layers characterized by sclerenchymatous fibres which only serve to protect the fruit from external damage.

(N.B.—The meaning of the French summary of this paper is sometimes quite obscure.) A. W. E.

The Value of the Haploid Generation in Determining the Systematic Position of the Balsaminaceæ.—P. N. SCHURHOFF ("Die Haploidgeneration der Balsaminaceen und ihre Verwertung für die Systematik," *Bot. Jahrb.*, 64, 4, 324-52, 5 pls.). In the first nine pages of this paper previous work on the development of the male and female gametophytes of the Balsaminaceæ is reviewed. A detailed account is then given of the author's work on the development of the haploid generation in *Impatiens parviflora* D.C. and *Hydrocera triflora*. Some of the more important features of systematic value in the haploid generation of the Balsaminaceæ are: (1) the binucleate pollen grains; (2) the existence of a cellular periplasmodium; (3) the possession by the endosperm of a micropylar haustorium; (4) the absence of a suspensor haustorium. There is a long discussion of the relationships of the Balsaminaceæ to the Geraniales and Sapindales respectively. The author agrees with the conclusion of Wettstein that the Balsaminaceæ are connected with the Sapindales. However, he goes further in stating that he considers that they should be placed in a new order, the Balsaminales consisting of one family, the Balsaminaceæ. C. R. M.

Early Evolution of the Angiosperms.—H. HAMSHAW THOMAS ("The Early Evolution of the Angiosperms," *Ann. Bot.*, 45, 647-72, 9 figs.). The author has dealt with the subject from the standpoint of a palæobotanist working with plants and structures that actually existed in the past. Although flowering plants have been traced to Jurassic times there is no indication of the nature of their immediate

ancestors, and to discover any possible evolutionary tendencies it is necessary to examine "all the known megaphyllous gymnosperms of the Early Mesozoic." In this connection the Bennettitales possessed fertile members restricted to shoots of limited growth, and also flower-like structures. The Caytoniales of the Lower Jurassic had ovules surrounded by a cupule-like envelope, a stigma, and anther-like synangia. Certain morphological conceptions are discarded by the author for lack of evidence. Thus, there is no reason to suppose that anthers have been evolved from "flattened foliar organs," since anther-like structures have been found on very early gymnosperms. "The view that the simple angiospermous carpel was derived from a structure like the *Cycas* megasporophyll is regarded as entirely without foundation." A comparative study of the venation of the follicles of some present-day Ranunculaceæ lends support to the suggestion that the carpel has been derived from a compound sporophyll. A preliminary description is given of a new type named *Umkomasia* which supports the suggestion that the Caytoniales were connected with the Pteridosperms, and also that the tendency to angiospermy may have occurred in several distinct groups of Pteridosperms.

C. R. M.

CRYPTOGAMIA.

Pteridophyta.

Isoetes.—JOHANNA LIEBIG ("Ergänzungen zur Entwicklungsgeschichte von *Isoetes lacustris* L.," *Flora*, 1931, 125, 321-58, 18 figs., 3 pls.). Some additions to our knowledge of the development of *Isoetes lacustris* with a historical account of previous work on the genus. The detailed structure of the roots, the stem, and the leaves is described; the development of the microprothallium, the maturing of the spermatozoids, and their structure; the macroprothallium, its one (or more) archegonium, and the young embryo.

A. G.

Propagation of Equisetum.—JOHN H. SCHAFFNER ("Propagation of *Equisetum* from Sterile Aerial Shoots," *Bull. Torrey Bot. Club*, 1931, 58, 531-5). An account of some experiments undertaken for the double purpose of discovering how readily species of *Equisetum* could be propagated from aerial sterile shoots, and of obtaining evidence which would throw light upon the problem of differentiation in relation to the reproduction of the individual. The species used for the experiments were *E. præaltum* and *E. arvense*. The author discusses the degree to which differentiation of shoots may proceed without losing the power of embryonic activity under suitable conditions.

A. G.

Aphlebiæ of Hemitelia.—ARTHUR W. HILL ("The Aphlebiæ of *Hemitelia capensis*," *Ann. Bot.*, 1932, 46, 183-5, 1 fig.). A note on the aphlebiæ, or modified pinnae, of the frond of *Hemitelia capensis*, and the function attributed to them by Marloth of acting as stipules protecting the young foliage from drought, and having the power of assimilation. At the beginning of last century they were regarded as independent epiphytes of Hymenophyllaceous nature.

A. G.

Affinities of Ferns.—ALICE LANDMANN ("Beiträge zur Kenntnis der Verwandtschaftsverhältnisse einiger Farngattungen (*Neurogramme*, *Asplenopsis*, *Trismeria*, *Selligwea*, *Pleopeltis*, *Loxogramme*, *Dictyopteris*, *Triphlebia*, *Diplora* und *Diplaziopsis*)," *Flora*, 1931, 125, 359-426, 30 figs.). An anatomical investigation of genera which have mostly been classified upon their superficial characters. *Neurogramme* must be suppressed and its species transferred to *Ceropteris*, *Coniogramme*, *Gymnogramme*, *Syngamme* (all of the *Gymnogramme* group), and to

Gymnopteris (allied to *Notochlæna*). *Aspleniospis* is an independent genus near to the *Syngrammeæ*. *Trismeria* is most nearly allied to *Coniogramme*. *Selligoea* is derived from *Pleopeltis* at various points. The species of *Pleopeltis* with peltate hairs have proved to be not congeneric, but belong to various allied groups. *Lozogramme* should be regarded as a side-branch of *Pleopeltis*. *Dictyopteris* is of closest affinity with *Aspidium*. *Triphlebia* and *Diplora* fall under *Phyllitis*. *Diplotziopsis* comes under *Diplazium* near to *D. marginale*. A. G.

Lomagramma in America.—R. C. CHING ("The Genus *Lomagramma* in America," *Amer. Fern Journ.*, 1932, 22, 15-18). *Lomagramma* is distinguished by its wide-scandent habit, its articulate pinnæ with reticulate venation, and by the absence of lateral main veins. The genus has hitherto been regarded as exclusively Asiatic. But it is pointed out by the present author that *Polypodium guianense* Aublet, referred to *Leptochilus* by Christensen, is so very nearly allied to the East Indian *Lomagramma lomarioides* that it must be transferred to that genus, of which it becomes the first known American representative; its range is from South Brazil to the West Indies. A. G.

Vittaria in China.—R. C. CHING ("The Studies of Chinese Ferns. VI. Genus *Vittaria* of China and Sikkim-Himalaya." *Sinensta*, Nanking, 1931, 1, 175-92, 5 figs.). The genus *Vittaria* as limited by the author is distinct from *Pteropsis*, *Drymotenium*, and *Scleroglossum*, and may be divided into three natural sections—*Euvittaria* Hook., *Haplopteris* Presl. (*Tæniopsis* J. Smith), and *Pseudotænitis* Ching. The list comprises twenty-one species with synonymy, distribution, and critical notes; and seven of these species are new to science. A. G.

Ferns of N.W. Africa.—LOUIS EMBERGER-FLAHAULT ("Les Ptéridophytes du Nord-Ouest de l'Afrique (Maroc, Algérie, Tunisie)," *Travaux Cryptogamiques dédiés à Louis Mangin*, Paris, 1931, 127-33). A list of thirty-eight ferns and twelve fern allies which have been recorded from north-west Africa. The three countries, Morocco, Algeria, Tunisia, have twenty-three species in common; nine others are peculiar to Morocco, six to Algeria, one to Tunisia. From another point of view, three of the species are boreal, twelve are temperate, fifteen are Mediterranean, seven are Atlantic, six are tropical, six are cosmopolitan, and one is endemic. A. G.

Wyoming Ferns.—LEO A. HANNA ("Distribution of the Ferns of Wyoming," *Amer. Fern Journ.*, 1932, 22, 1-11, Map). A list of nearly a score of ferns with their localities in Wyoming. Their distribution is graphically represented in a map of the State. Keys to the genera and to the species are supplied. A. G.

West Indian Ferns.—WILLIAM R. MAXON ("New Tropical American Ferns—IX," *Amer. Fern Journ.*, 1932, 22, 11-15). Descriptions of two new ferns—*Elaphoglossum nematorhizon* from the summit of Blue Mountain Peak, Jamaica, which probably represents the doubtful *E. Lindenii* recorded by Jenman in his Synoptical List; and *Adiantopsis asplenioides*, a rare fern from the province of Pinar del Río, Cuba, to which is referred No. 881 collected by Charles Wright in East Cuba and named *A. paupercula*, and subsequently *Hypolepis Gardneri*. A. G.

Roraima Ferns.—C. V. MORTON ("Goebel's 'Roraima Ferns,'" *Amer. Fern Journ.*, 1932, 22, 19-23). In discussing Goebel's "Archegoniatenstudien XVIII, Roraimafarne," published in "Flora," 1929, n. ser. 24, 1-37, where *Hymenophyllopsis*, a new genus, was described in detail, the present author points

out that it is with little doubt identical with *Hymenophyllum dejectum* Baker, collected on the summit of Mount Roraima by Im Thurn; but the genus has no affinity with *Hymenophyllum*. Its systematic position has yet to be determined.

A. G.

Japanese Ferns.—HIROSI ITÔ ("On the Distribution of Ferns in the Southern Part of Japan Proper," *Tokyo Bot. Mag.*, 1931, 45, 390-404, 4 figs.). The four districts studied are Sikoku Island, Kii Peninsula, Idzu Peninsula, Bôso Peninsula, and in their coastal fern flora they are rich in Malayan and South Chinese elements. Frigid elements are seen only in the Alpine region of Sikoku. Numerous species are in common with Corea, Shantung, and Central China. Endemic species are numerous. Temperature, far more than humidity or geology, is the controlling factor in the distribution. The enumeration comprises 223 species and several varieties.

A. G.

Bryophyta.

Morphology of Riccia.—F. M. PAGAN ("Morphology of the Sporophyte of *Riccia crystallina*," *Bot. Gaz.*, 1932, 93, 71-84, 24 figs.). After fertilization in *Riccia crystallina*, the embryo quickly enlarges and becomes surrounded by a thin wall; the cells of the venter enlarge, divide, and produce a two-layered calyptra. The first division of the zygote is transverse or inclined to the archegonial axis; by further divisions the quadrant and octant stages are formed; and gradually a globular mass of cells results, in which by periclinal divisions the sporangial wall is set off from the sporogenous tissue. The spore mother-cells become rounded off and are surrounded by an abundance of food material from the breaking down of other cells. The resorption of the sporangium wall usually takes place late and is connected with the food supply of the developing spores. Some of the cells of the potential sporogenous tissue become abortive during spore formation. Sterile cells are not confined to the periphery of the sporangium, but may also be found in the interior; they may be regarded as forerunners of the elaters of higher forms of Hepaticæ. The failure of potential sporogenous tissue to produce spores seems mainly a matter of food supply.

A. G.

Anthoceros from Rangoon.—L. P. KHANNA ("A New Species of *Anthoceros* from Rangoon," *Bot. Gaz.*, 1932, 93, 103-4, 6 figs.). Description of *Anthoceros Weistei*, a new species of hepatic which is common in shady places in Rangoon during the months of May to October. It has unicellular pseudo-elaters and spinous spores.

A. G.

Lunularia.—G. CHALAUD ("La spermatogénèse chez *Lunularia cruciata* (L.) Dum.," *Travaux cryptogamiques dédiés à Louis Mangin*, Paris, 1931, 113-126, 2 pls.). The results of this investigation are as follows. The antheridium of *Lunularia* develops along the lines typical of the Jungermaniales. The mother-cell of the antheridium contains a nucleus, a vacuome, and a chondriome, but no clear plastidome. A parietal tissue is rapidly developed around the mother-cell, the cytoplasm of the latter remaining in a state of activity. Before the nucleus lengthens, the chondriosomes elaborate granules of reserve material, which will become used up during the formation of the spermatozoid. Mitosis leads to the formation of eight autosomes; centrosomes have not been seen. The body of the spermatozoid is formed solely from the nucleus, doubtless much modified in its intimate nature during the process. The blepharoplast lengthens out in front of the nucleus and is biciliate.

A. G.

Marchantia after Fires.—RAYMOND H. TORREY ("Marchantia polymorpha after Forest Fires," *Torrey*, 1932, 32, 9-10). Describes a wide-spread occurrence of *Marchantia polymorpha* last autumn on Kittatiny Mountain, in Warren County, New Jersey, after the destruction of the vegetation by forest fire in the previous autumn. A similar development of *Marchantia* occurred on Long Mountain in the Harriman State Park, and persisted for two or three years until taller herbaceous and shrubby vegetation reappeared. A. G.

Hepaticæ of Java and Sumatra.—F. VERDOORN ("De Levermosgeslachten van Java en Sumatra," *Nederlandsch Kruidkundig Archief*, Jaargang, 1931, Amsterdam, 1932, 461-509, 94 figs.). Keys to the twenty-two families and ninety-four genera of hepaticæ recorded for Java and Sumatra, illustrated by figures for each genus. A. G.

Dutch Hepaticæ.—W. H. WACHTER ("Naamlijst der Nederlandse Lever mossen," *Nederlandsch Kruidkundig Archief*, Jaargang, 1931, Amsterdam, 1932, 528-532). A list of hepaticæ of Holland, comprising forty-five genera and ninety-four species. A. G.

Moss Plastid.—T. ELLIOT WEIER ("A Study of the Moss Plastid after Fixation by Mitochondrial, Osmium and Silver Techniques. II. The Plastid during Spermatogenesis in *Polytrichum commune* and *Catharinea undulata*," *La Cellule*, 1931, 41, 49-85, 3 pls.). Spermatogenesis in *Polytrichum commune* and *Catharinea undulata* is here worked out in detail, special attention being given to the development of the plastid. The author gives a description of spermatogenesis after mitochondrial fixation, and of spermatogenesis after fixation according to Kolatchev. Also he describes silver impregnation techniques. He then discusses the plastid in the androgones; the origin of the limosphere; the Golgi body as compared with the plastid; the antherozoid structure; the chondriome; and finally gives a comparison of the cytoplasmic structure in animal and plant cells. A. G.

Cytology of Funaria.—MARTHA LYDIA BEARDSLEY ("The Cytology of *Funaria flavicans* Michx. with Special Reference to Fertilization," *Ann. Missouri Bot. Garden*, 1931, 18, 509-40, 1 fig., 3 pls.). Sporelings of *Funaria flavicans* were grown in careful culture; fertilization of the mature archegonia was effected by flooding; fixations of material were made at intervals and examined. The volume of the egg and the nucleus were found to be about one-eighteenth and one-fortieth of those of *Riccardia* respectively. The antherozoid penetrates the cytoplasm of the egg gradually and for the most part at the basal end; the male nucleus becomes spherical, approaches the female nucleus and passes into it. The region around the condensed chromatin of the female nucleus is very clear, but round the male nucleus is granular. The nuclear membrane meanwhile disappears; after the fusion of the female and male nuclei, a nuclear membrane reappears. Before fertilization a mucilaginous plug is developed in the neck of the archegonium, and is believed to be a secretion of the first two tiers of neck-cells above the venter. No fusion of egg-cell with ventral canal was observed. Cytokinesis of the spore mother-cell is by cell-plate formation. A. G.

Orthotrichum.—G. DISMIER ("Une mousse nouvelle pour la Bryologie (*Orthotrichum pseudostramineum*) dans le haut Vivarais," *Archives de Botanique*, 1929, 3, 169-70). Description of a new species of *Orthotrichum*, related to *O. stramineum* and *O. alpestre* in its stomata, but distinct from the former in its

saxicolous habit and glabrous vaginule, and from the latter in its non-striate papillose teeth. It grows on a well-shaded granite wall at a farm near Borne in Ardèche.

A. G.

Dalmatian Mosses.—A. LATZEL ("Vorarbeiten zu einer Laubmossflora Dalmatiens," *Beih. z. Bot. Centralbl.*, 1931, **48**, ii, 437–512, 4 figs.). An account of the moss flora of Dalmatia. Previously 182 species had been recorded; the present enumeration adds 126 species and numerous varieties and forms to the flora, including four new species and several varieties. A resumé is also given of the publications of previous authors on the subject, as well as ecological notes and remarks on the relationship of the moss flora to those of the Adriatic, Mediterranean, and Atlantic countries.

A. G.

Japanese Mosses.—H. REIMERS and K. SAKURAI ("Beiträge zur Moosflora Japans. I," *Engler's Bot. Jahrb.*, 1931, **64**, 537–60, 4 pls.). An enumeration of the mosses collected since 1908 by Dr. K. Sakurai, chief doctor of the Tokio Railway Hospital, during numerous journeys in different parts of Japan and a few visits to Korea. Previous collections were named by K. Warnstorf and by V. F. Brotherus; the latter dedicated a new genus, *Sakurania*, to the discoverer. The present contribution contains 220 species and numerous varieties, including eleven new species and a new genus, *Actinostoma*.

A. G.

Thallophyta.

Algæ.

Snow Algæ.—E. KOL ("Sur un nouveau représentant de la flore nivale de la Suisse," *Bull. Soc. Bot. Genève*, 1931, **23**, 428–32, 2 pls.). A description of *Raphidonema Chodati*, a new species of alga found on snowfields near the Grand Combin and near the Eiger Glacier in the Swiss Alps. The two forms of multiplication effected by this fusiform alga are represented by numerous figures. The species is closely contrasted with *R. brevirostre* Scherffel, from which it differs in shape and size of cell and in form of chromatophore. Associated with the plant were the following snow algæ: *Scotiella nivalis*, *Chlamydomonas nivalis*, *Raphidium nivale*, forms of *Cosmarium* and *Hormidium*, and *Chionaster nivalis*.

A. G.

Snow Algæ.—E. KOL ("Nouveaux documents se rapportant à la cryovégétation de la Suisse," *Bull. Soc. Bot. Genève*, 1931, **23**, 435). Records the discovery of *Raphidonema brevirostre* Scherffel in the neighbourhood of the Great Saint Bernard Pass in Switzerland. This alga had been found previously in the Tatra Mountains of Hungary by Prof. Györfy in 1909.

A. G.

New Cyanophyceæ.—PIERRE FRÉMY ("Deux Cyanophycées nouvelles de l'Inde méridionale," *Travaux Cryptogamiques dédiés à Louis Mangin*, Paris, 1931, 103–8, 2 pls.). Descriptions of two new Cyanophyceæ collected at an altitude of 6000 feet on Shembanagur in Madras Presidency, namely *Rivularia Mangini* and *Tolypothrix Foreaui*.

A. G.

Nevada Diatoms.—G. D. HANNA and W. M. GRANT ("Diatoms of Pyramid Lake, Nevada," *Trans. Amer. Microsc. Soc.*, 1931, **50**, 281–97, 3 pls.). An account of the diatoms dredged from a depth of 150 feet in Pyramid Lake, Nevada, in June, 1927. The list contains thirteen species, one of which, *Surirella nevadensis*, is new to science. The authors discuss the geological history of Pyramid Lake, which is a relic of the far larger Lake Lahontan which occupied that part of Nevada in

Quaternary times; it has no outlet, and has only one important inlet—Truckee River. Freshwater lakes of vast extent existed in Western America in Tertiary and in Miocene times. Almost all the diatoms in the present list are decidedly marine in normal habitat, but also occur in brackish waters; but the fishes of the lake are of freshwater type. Analysis shows the water to contain one-tenth the NaCl of ocean water, but is decidedly alkaline with carbonates. A. G.

Japanese Diatoms.—B. W. SKVORTZOW ("Diatoms from the Bottom of the Sea of Japan," *Philippine Journ. Sci.*, 1932, 47, 265–80, 4 pls.). A list of the diatoms found in five samples of sea mud collected in 1921–25 by the Imperial Fisheries Institute of Tokyo and sent to the author by Dr. K. Okamura. The material contained eighty-three species and varieties, including two new species and four new varieties. A. G.

Aërophilous Algæ.—K. BISWAS ("The Rôle of Aërophilous Algæ in producing Colour-Effect on the Bark of *Oreodoxa regia* of the *Oreodoxa* Avenue in the Royal Botanic Garden, Calcutta," *Hedwigia*, 1932, 72, 31–41, 1 pl.). A study of the habit and growth of the algæ which decorate with conspicuous red, green, and black vertical bands the trunks in the *Oreodoxa* Avenue in Calcutta Botanic Garden. The deep rusty-red colour is due to *Trentepohlia umbrina*, the green to *Protococcus viridis*, the black to *Scytonema ocellatum*. The algæ select positions most favourable to their well-being by reason of suitable shade and humidity, and flourish during the south-west monsoon. During the dry season they shrivel and become powdery or fragile, and fragments are subsequently carried away by wind or storm, to restart life in new situations. *Trentepohlia odorata* and *T. iohikus* var. *bovina* are also a noteworthy feature on trees and walls respectively. A. G.

Forsskål's Algæ.—F. BØRGESSEN ("A Revision of Forsskål's Algæ mentioned in Flora ægyptiaco-arabica and found in his Herbarium in the Botanical Museum of the University of Copenhagen," *Dansk Botanisk Archiv.*, 1932, 8, No. 2, 1–15, 1 pl., 4 figs.). The first account of P. Forsskål's plants was published in 1775. Out of thirty-six algæ named by him eight are either unknown or cannot be found in the Copenhagen Museum. The rest are discussed in the present Paper, and their modern names and synonymy are given. Some new combinations were necessitated by the priority of Forsskål's specific names. A. G.

Erythrotrichia and Erythrocladia.—PIERRE DANGEARD ("Sur quelques *Erythrotrichia* et *Erythrocladia* de Banyuls et du Croisic," *Le Botaniste*, 1932, 24, 143–54, 3 pls., 2 figs.). A discussion of *Erythrocladia subintegra* Rosenv. and *E. polystromatica*, a new species found on *Laminaria flexicaulis* at Le Croisic; also of *Erythrotrichia discigera* Berthold, *E. obscura* Berthold, and *E. reflexa* (Cr.) Thuret. These little algæ are as yet incompletely known. The author gives valuable illustrations of them, and throws new light upon their cellular structure. A. G.

Studies of Florideæ.—HARALD KYLIN ("Über die Entwicklungsgeschichte der Florideen," *Lunds Universitets Årsskrift*, 1930, N.F. Avd. 2, 26, No. 6, 1–104, 56 figs.). An account of the reproductive apparatus in some twenty-six genera of Florideæ belonging to eighteen families grouped in the following tribes: Nemalionales, Cryptonemiales, Gigartinales, Rhodymeniales, Nemastomales, Ceramiales. This is followed by a general discussion of the main characters of the reproductive apparatus which are of systematic value in the different families, and by a chapter on the relationships of the various families in each tribe. A. G.

Gelidium.—JEAN FELDMANN ("Remarques sur les genres *Gelidium* Lamour., *Gelidiopsis* Schmitz et *Echinocaulon* (Kütz.) emend.," *Travaux Cryptogamiques dédiés à Louis Mangin*, Paris, 1931, 151–66, 4 figs.). A review of the anatomical characters of *Gelidium*, *Gelidiopsis* and *Echinocaulon*, and an indication of the species which should be referred to the second and third of these genera. In brief, *Gelidium* has an apical cell, elongated medullary cells which diminish in size towards the cortex of small rounded cells which are limited at the periphery by a layer of very small cells containing chromatophores. The inner cells are prolonged at their lower end into thick-walled hyphæ which penetrate in numbers between the cells of the inner cortex and sometimes between those of the middle region, and are specially numerous in the other parts of the frond. *Gelidiopsis* differs in having a cap of apical cells which produce the filaments constituting the thallus; the medulla is a bundle of long, narrow cells surrounded by shorter, wider cells which diminish in size till the close-set superficial layer is reached. The type is *G. variabilis*. *Echinocaulon* has a distinct apical cell, medullary cells less coherent than in *Gelidium*, and a cortex of small spherical cells, but there are no intercellular hyphæ. The type is *E. rigidum* Kütz.; *E. setaceum* (Guadeloupe, Mazé and Schramm, No. 1834), and *E. nigrescens* (Algeria) are new species.

A. G.

Embryology of Sargassum.—SHUMPEI INOH ("Embryological Studies on *Sargassum*," *Sci. Reports Tôhoku Imp. Univ.*, Sendai, Japan, 1930, 4th ser., 5, 423–38, 13 figs.). Study was made of the development of the oospores of a dozen species of *Sargassum*—of the first and subsequent segmentation walls, and especially of the further segmentations of the rhizoid cell, which are characteristic of each species. Three types can be recognized: (1) irregular eight-cell type, where the rhizoid cell divides into eight irregularly arranged segments, from each of which is produced a rhizoid; (2) sixteen-cell type, where the sixteen segments are irregularly arranged and produce a rhizoid each; (3) radial eight-cell type, where the eight cells are radially arranged and each produce a rhizoid, but in addition is another group of rhizoids arising from the cells situated just behind the rhizoid cell. There is a striking difference in size of the eggs of the different species, and usually those of the sixteen-cell type are much larger than the eight-cell type; and that of *Cystophyllum sisymbrioides* is still larger, and may be called a thirty-two-cell type. The species with larger eggs should probably be regarded as higher in systematic position.

A. G.

Algal Confusions.—W. A. SETCHELL ("Some Early Algal Confusions," *Univ. Calif. Pub. Bot.*, 1931, 16, 351–66, 1 pl.). The author gives a brief historical account of early algologists, their publications and their collections, and discusses the nomenclature of *Codium tomentosum* Stackh., *Himanthalia lorea* Lyngb., and *Gelidium corneum* Huds. A careful investigation of types and literature leads him to propose the new combinations *Codium dichotomum* and *Himanthalia elongata* for the two former plants, and to leave the *Gelidium* for further consideration.

A. G.

Danish Algæ.—L. KOLDERUP ROSENVIINGE ("The Marine Algæ of Denmark. Contributions to their Natural History. Part IV. Rhodophycæ IV (Gigartinales, Rhodymeniales, Nemastomatales)," *Mém. Acad. Roy. Sci. Danemark*, 1931, 7^{me} Série, 7, 489–628, 165 figs., 1 pl.). A continuation of the life history of the Danish algæ. The present part treats of the Gigartinales, comprising the genera *Harveyella*, *Chondrus*, *Gigartina*, *Phyllophora*, *Ceratocolax*, *Ahnfeltia*; the Rhodymeniales, with *Rhodymenia lomentaria*; the Nemastomatales, with *Cystoclonium*, *Euthora*;

Rhodophyllis, *Plocamium*, *Gracilaria*. There is a chapter giving a summary of the reproduction and alternation of generations of these genera. And in an appendix is some supplementary information about some genera of Bangiaceæ, Naccariaceæ and Rhizophyllidaceæ, as also about *Conchocelis*, a perforating alga, the systematic position of which is doubtful. A. G.

Taonia.—WILFRID ROBINSON ("Observations on the Development of *Taonia atomaria* Ag.," *Ann. Bot.*, 1932, 46, 113–120, pl.). A posthumous Paper on *Taonia atomaria*. The sexual phase of this alga is rare. The tetrasporiferous phase shows a rhythmic production of bands of hairs and tetrasporangia at the apex of the thallus, but subsequently intermediate cells of the thallus may become tetraspore mother-cells. There is apparently a correlation between the production of tetrasporangial bands and the daily rhythm of the tides; and rhythmic differences in the density of sporangia in adjoining zones suggest a correlation with different amounts of light received by the apical margin in inter-tidal periods. Germlings of two kinds adhering to old thalli were collected at Aberystwyth, and upon investigation were found to have arisen from single tetraspores in the one case and from the undivided contents of the tetrasporangium in the other. By cultivation it was noticed that the plants derived from undivided tetrasporangia had greater vigour of growth than the others, and this may afford a clue to the predominance in Nature of the tetrasporic plants. A. G.

British Seaweeds.—LILY NEWTON ("A Handbook of the British Seaweeds," London, Trustees of the British Museum (Natural History), 1931, xiii and 478 pp., 270 figs.). A catalogue of our British marine algæ, comprising some 260 genera and 750 species, with descriptions in as simple language as possible of the orders, families, genera, species and varieties, and with 270 text-figures, mostly by the late Percy Highley. Actually there must be over 1100 drawings, since often five to eight are allotted to a genus, illustrating structural detail and reproductive organs. Another important feature is the abundance of keys to the genera and to the species. A glossary and a list of authors, with dates, are included. The introduction treats of the occurrence, distribution, and zonation of algæ; collecting and preserving, economic uses, classification, life history. A. G.

Manx Algæ.—MARGERY KNIGHT and MARY W. PARKE ("Manx Algæ. An Algal Survey of the South End of the Isle of Man," *L. M. B. C. Memoirs*, University Press of Liverpool, 1931, xxx, 1–155, 2 maps, 2 figs., 19 pls., 1 table). The results of some years of study of the algæ of the Isle of Man, comprising an introductory description of the area studied; the effects of alternating seasons on the algal vegetation, perennials, annuals, etc.; annual migrations in the littoral zone; systematic list; critical notes; analytical key; bibliography; table of reproduction. The number of species in the systematic list is 349, an increase of 99 records since 1913. Cyanophycæ and diatoms are not included. The locality, zone, time of occurrence, and time of reproduction of each species are given, as well as a reference to a published figure. A. G.

Australian Algæ.—A. H. S. LUCAS ("Notes on Australian Marine Algæ. VI. Descriptions of Six New Species," *Proc. Linnean Soc., N.S.W.*, 1931; 56, 407–11, 5 pls.). The new algæ from Australia and Tasmania described by the author are *Gelidium rectangulare*, *Pterocladia pectinata*, *Nitophyllum* (*Myriogramme*?) *Perrineæ*, *Champia insignis*, *Lessonia corrugata*, *Caulerpa annulata*, and photographic illustrations of *Caulerpa Cliftoni* Harv., *Dictyota bifurca* J. Ag., and *D. alternifolia* J. Ag. are added. A. G.

Fungi.

Study of Chytridiales.—JOHN S. KARLING ("Studies in the Chytridiales. VII. The Organization of the Chytrid Thallus," *Amér. Journ. Bot.*, 1932, **19**, 41-74, 138 text-figs.). The thallus of this group is of a rhizoid nature and is distinguished by the tapering points of the rhizoidal hyphæ. Karling discusses the difference within the order—the manner of growth of the various initial strands, and their behaviour within the host, and the methods of propagation, as also the various developmental stages.

A. L. S.

New Genus of Chytridiales.—W. R. IVIMEY COOK ("The Life History of *Cystochytrium radicale* occurring in the Roots of *Veronica Beccabunga*," *Trans. Brit. Mycol. Soc.*, 1932, **16**, 246-52, 19 text-figs., 1 pl.). It was at first thought by the author that he was dealing with one of the protozoa, but the affinity was found to be with the Chytridiales. It attacks the roots of *Veronica Beccabunga*, the earliest stage being a small unicellular uninucleated body. The life history was followed by examining the attacked host at many stages. The primary cell becomes multinucleate and functions as a zoosporangium. The zoospores emerge in water, swim about, and enter other roots. The host plant is not visibly affected by the presence of the fungus. The new genus is considered as closely allied with *Hypochytrium*.

A. L. S.

Disease due to Phytophthora.—S. V. VENKATARAMAN ("Phytophthora Arecae, Parasitic on Areca Tops and a Strain of *P. palmivora* Butl. (*P. Faberi* Maubl.) on a New Host, *Aleurites Fordi*," *Phytopathology*, 1932, **22**, 217-27, 4 text-figs.). The fungus *Phytophthora Arecae* has been known as causing a disease of Areca nuts. It was also found that a somewhat similar fungus attacked and killed the tops of the palms. Investigation by culture experiments proved that the trouble was due to the same fungus, a species of *Phytophthora*. No oospores were formed in pure cultures, but they were formed in cultures paired with *Phytophthora* from the Sandal, *Santalum album*, their formation being accompanied by the characteristic brown line at the junction of the two mycelia. Antheridia and oogonia were formed. Oospores were also formed in conjunction with the *Phytophthora* from *Aleurites Fordi*, but only very slowly. The fungus on *Aleurites* has also been examined and cultured. Chlamydospores were formed in the cultures of the *Areca* tops in Mysore.

A. L. S.

Development in Pilobolus.—C. T. INGOLD ("The Sporangiophore of *Pilobolus*," *New. Phyt.*, 1932, **31**, 58-63, 2 text-figs.). Ingold has described the gradual growth of the Sporangiophore of *Pilobolus Kleinii*—its development and dehiscence. It grows almost invariably on the dung of herbivorous animals; the non-septate mycelium germinates in the animal intestine, the first appearance being a minute orange bulb. These were noted between 3-5 p.m. and were watched to the final discharge between 9 and 12 o'clock of the following day. Each stage is described and is illustrated by figures.

A. L. S.

Cucurbitaria Laburni.—F. MARY GREEN ("Observations on *Cucurbitaria Laburni* (Pers.) de Not.," *Trans. Brit. Mycol. Soc.*, 1932, **16**, 289-303, 5 text-figs.). The fungus here described grows on the dead branches of laburnum trees, but inoculations have proved that it cannot be regarded as a parasite on normal trees. It is also capable of growing on the dead wood of elm and black currant. Investigation showed that the mycelium penetrated all the tissues but is most abundant in the xylem; the black perithecia are borne in groups on stromata which burst through the bark. Green has made a thorough study of all the fungi found growing

along with the *Cucurbitaria*, such as *Nectria* and *Fusarium*. Two types of pycnidia are part of the normal development: (A) with large brown muriform pycnosporos, and (B) with small ovate colourless spores, the latter probably an incomplete development. *Phomopsis rudis* also occurs but is unconnected with the *Cucurbitaria*.

A. L. S.

Heterothallism of Ascomycetes.—B. O. DODGE ("Heterothallism and Hypothetical Hormones in *Neurospora*," *Bull. Torrey Bot. Club.*, 1931, 58, 517–22, 1 text-fig.). The writer discusses the view held by M. and Mme. Moreau that heterothallism in *Neurospora* is nothing more than a matter of diffusible hormones and that the real act of fecundation occurs when two nuclei fuse in the ascus; they also state that though sclerotia-like bodies are often produced in single-spored cultures, and that these may be stimulated to form asci, yet that can only be a very rare occurrence. The writer has experimented by growing in a U-tube two races of *Neurospora sitophila*: the hormone theory of heterothallism was not confirmed. It required, he found, always the contact of two mycelia for the further growth and the final formation of perithecia and asci.

A. L. S.

White Form of *Pyronema confluens*.—W. J. BEAN and F. T. BROOKS (*New Phyt.*, 1932, 31, 70–71). The apothecia of *Pyronema confluens* are normally pink-coloured, but a white form, described by the authors, appeared in cultures and persisted through other series of cultures, the only difference being in the pigment; sexual organs and spores are normal. In coloured forms the white mycelium turns pink in sunlight, in the white form under the same conditions there is no change.

A. L. S.

Study of Helvellaceæ.—SANSHI IMAI ("Contribution to the Knowledge of the Classification of *Helvellaceæ*," *Bot. Mag. Bot. Soc. Japan*, 1932, 46, 172–75). Imai describes the family *Helvellaceæ* as differing from others allied by the possession of a stipe; he unites with *Helvella* the genera *Verpa*, *Helvella* n.g., *Neogyromitra* n.g., and *Morchella*. The new genera are distinguished by spore-characters. A number of new species are included in this survey, and the new species are carefully described with Latin diagnoses.

A. L. S.

Study of Elaphomyces.—MARIEN CLÉMENCET ("Contribution à l'étude du développement et de l'anatomie des Ascomycètes hypogés, les Elaphomycetacées," *Le Botaniste*, 1932, 24, 2–81, 16 text-figs., 12 pls.). The author gives first a historical account of the family, then proceeds to a description of her working methods, finally a classification and full account of the species dealt with. A new genus is proposed for stalked forms, *Ascoscleroderma*, with the species *A. cyanosporum*, formerly known as *Elaphomyces cyanosporus*. A very full account is given of the development of this species, both of the general structure and of the fruiting bodies. *Elaphomyces* has also been similarly studied and described in great detail. Particular attention was paid to "Mycorrhiza" in *Ascoscleroderma*, not only as radicles on the surface, but those that were found to penetrate the internal tissues of the fungus. These rootlets are described, and also similar rootlets in *Elaphomyces Leveillei*. The association with mycorrhizal rootlets is entirely in favour of the fungus which dissolves part of the membrane and uses up the carbon of the root; the term symbiosis does not apply in this case, according to the writer.

A. L. S.

Cytology of *Aspergillus*.—K. WAKAYAMA ("Contributions to the Cytology of Fungi. III. Chromosome Number in *Aspergillus*," *Cytologia*, 1931, 21–301, 53 text-figs.). Wakayama used for his research thirteen species of *Aspergillus*.

In all of them he found the haploid number of chromosomes to be 2. He has proved that the conidiophores are asexually reproducing organs. In all cases the sterigma was uninucleate, the chromosomes split into two halves, the conidiophore being an organ of asexual reproduction. The process of division is described in detail, mitosis going on regularly as in the mitosis of higher organisms. As a result two daughter nuclei are formed: the apical one migrates through the narrow neck into the swelling at the apex of the sterigma, the process is repeated, resulting in chains of conidiospores. The two chromosomes are small and round in shape without much difference in size or shape.

A. L. S.

Study of Aspergillaceæ.—ADALBERT BLOCHWITZ ("Perithezien, Sklerotien und Eidamsche Blazen der Aspergillaceen," *Beih. Bot. Centralbl.*, 1932, 49, 262-92). Blochwitz has made a comparative study of the occurrence of perithecia, sclerotia, and Eidam swellings in the various genera of Aspergillaceæ. Perithecia are rare and in some species are not known to occur—their size is variable as also the size of the spores. Sclerotia also are variable in size and their formation depends on external conditions: moisture favours perithecia and sclerotia; a dry atmosphere is necessary for conidial structures. As to the Eidam structures which arise on the hyphæ, Blochwitz considers them to be abortive or rudimentary apothecial initials. But their characters are of value in the determination of relationship between different species.

A. L. S.

Study of Capnodiaceæ.—JOSÉ M. MENDOZA ("Two New Species of Sooty Molds from the Philippines," *Philippine Journ. Sci.*, 1932, 47, 289-93, 2 pls.). The two fungi *Scorias philippensis* and *Parascorias spinosa* grew on leaves—the former on *Ficus*, the latter on *Smilax*. Both formed perithecia with ascospores, the spores large and paraphyses absent. *Parascorias spinosa* is distinguished by the spiny cells of the gelatinous mycelium.

A. L. S.

Notes on Fungi.—P. LUIS M. UNAMUNO ("Notas micológicas," *Bol. Soc. Esp. de Hist. Nat.*, 1931, 701-10). The fungi described in this Paper were collected from several localities in the South of Spain, by the author or by various assistants. Those now published belong to the Sphærospideæ—*Phyllosticta septorice* and others. A few species are new to science, others are from new habitats. A species of *Darluka* is recorded, the well-known *D. filum*, a parasite on the sori of rust fungi, and a new species of *Diplodia* on *Lolium perenne*.

A. L. S.

New Hyphomycete.—AROEIRA HEVES ("Sobre um hiphomiceto isolado de lesões esporotrichoides da face," *Memorias do Inst. Oswaldo Cruz.*, 1931, 25, 323-31, 1 pl.). The fungus in question was found growing on the skin of a chauffeur after an automobile accident. After cultures and researches the fungus was found to be a Hyphomycete, *Spondylocadium atro-violaceum* n. sp.: the sterile hyphæ creeping, septate; the fertile, erect, branched, and rigid; the conidia, fusoid, two-septate, and brown. A detailed account is given of the various experiments by infection, etc., to determine the fungus.

A. L. S.

New England Rusts.—GEORGE H. HEPLING ("A List of the New England Rusts collected in 1931," *Rhodora*, 1932, 34, 60-65). A long list of species collected recently in New Hampshire, Vermont, Massachusetts, and Connecticut, by the writer and by Dr. Perley Spaulding. They are very carefully tabulated, with indications as to whether they are new to the country or state, and with numerals to indicate the stage of growth.

A. L. S.

Effect of Light on Parasitic Fungi.—W. A. R. DILLON WESTON ("The Reaction of Disease Organisms to Certain Wave-lengths in the Visible and Invisible Spectrum," *Phytopatholog. Zeitschr.*, 1932, 4, 229-46). Weston has given the results of his experiments on the influence of light on the germination of rust spores. The different experiments are described in detail and the reaction of the spores, not only to light, but to different colours. In conclusion he states that "urediniospores do not germinate under sunlight or very high white intensities." They germinate in darkness or when the intensity of light is low. The author disclaims generalization in regard to other organisms, as all may react differently to wave-lengths, and may have their optima in regard to light as they have in regard to heat. Finally he states that "germination of urediniospores is no erratic phenomenon, but something fine, delicate, and exact, obeying well-defined laws."

A. L. S.

Study of Rusts.—JAMES M. WALLACE ("Physiologic Specialization as a Factor in the Epiphytology of *Puccinia graminis Triticci*," *Phytopathology*, 1932, 22, 105-44, 4 text-figs.). A large number of specialized forms of *Puccinia graminis* are known to exist, and Wallace has now made a study of these various forms by watching the migration of the disease from district to district. Over 100 different forms have been identified, sixty of which have been found in North America. The tests used to determine these rusts are mainly reinfection of material. A careful account is given of the prevalent forms along with the locality of incidence. The author notes that wind is now recognized as an important agent in rust dissemination.

A. L. S.

Effect of Bunt on Wheat.—E. N. BRESSMAN ("Effect of Bunt on Height of Wheat Plant," *Phytopathology*, 1932, 22, 259-62). Bunt of wheat includes two species, *Tilletia Triticci*, referred to as "low smut," and *T. levis* as high smut. Experiment and observation by carefully measuring many infected plants has confirmed the difference: in general, *Tilletia levis* infected plants are taller than those infected by *T. Triticci*. The writer adds, however, that varieties and environmental conditions have also to be taken into account. Full lists are given of the experiments and measurements.

A. L. S.

Study of Sphacelotheca.—R. BAUCH ("*Sphacelotheca Schweinfurthiana*, ein neuer multipolar sexueller Brandpilz," *Ber. Deutsch. Bot. Gesell.*, 1932, 50, 17-24, 1 text-fig., 1 pl.). Bauch describes at length his experiments and conclusions with regard to this genus of Ustilaginæ. In the final summary he states that the species studied shows typical tetrapolar sexuality. These two different types of copulation also show a difference in their future growth. In the first type there is no further development of the fused sporidia; in the second bi-nucleate hyphæ are formed with further development

A. L. S.

Germination of Smut Spores.—S. C. TENG ("Observations on the Germination of the Chlamydospores of *Tilletia horrida* Tak.," contribution from the *Biol. Lab. Sci. Soc. China*, 1931, 6, 111-14, 1 pl.). *Tilletia horrida* is the bunt of rice, and up to now the germination of the spores and the method of infection have remained unknown. Teng has successfully germinated spores in water after a rest period of about eleven months. It was observed that the immersed spores refused to germinate, only those at the edge of a drop were seen to be germinating, showing the need of oxygen in the process; the thick wall of the chlamydospore ruptured and the promycelium emerged and produced sporidia.

A. L. S.

Study of Ustilago Zeæ.—HERMANN OTTO SLEUMER ("Über Sexualität und Zytologie von *Ustilago Zeæ* (Beckm.) Unger," *Zeitschr. für Bot.*, 1932, 25, 209–63, 33 text-figs., 1 pl.). Sleumer records first of all the work of others on fertilization in the Smut fungi; he then describes his own methods of attacking the problem, revising the whole subject by means of cultures. He has verified the existence of heterothallism without which infection (or new growth) does not take place. He found that there were many different combinations, he describes them and their significance, but he considers that complete understanding has not been arrived at in the research of these very difficult organisms. He has found that the clamp connections observed by some workers are irregular formations without function.

A. L. S.

Study of Smut Fungi.—WERNER FEUCHT ("Die Wirkung des Steinbrandes *Tilletia Tritici* (Bjerkander) Winter und *Tilletia foetens* (Berk. & Curtis) Tulasne auf verschiedene Winterweizensorten bei künstlicher Infektion in ihrer Abhängigkeit von ausseren Faktoren," *Phytopatholog. Zeitschr.*, 1932, 4, 247–90, 5 text-figs.). In this exhaustive Paper Feucht has gathered together the results of many workers on the possibility of controlling attacks of the Smut disease. He has discussed the conditions that encourage or retard the parasite, such as temperature, moisture, the conditions of the soil, and the effect of previous crops. He then takes up the question of the different smuts as to which is the more virulent, and their occurrence in different districts. *Tilletia Tritici* he condemns as the more serious disease. Finally a list of eighty papers dealing with the subject is given.

A. L. S.

Fungus Cultures.—K. STG. CARTWRIGHT ("Further Notes on Basidio mycetes in Culture," *Trans. Brit. Mycol. Soc.*, 1932, 16, 304–07, 2 pls.). The fungi grown in cultures were *Polyporus fumosus*, *P. adustus*, and *Lenzites trabea*. Cartwright describes the macroscopic and microscopic characters observed: in the latter, the size and form of the hyphæ, the aerial and the submerged mycelium, the presence or absence of clamps; finally the spores and fruit-bodies. He then describes and compares with these the cultures of *P. adustus* and finds that they can be separately recognized by their growth characters. The former formed large rhomboidal crystals, the latter small rod-shaped crystals. *Lenzites trabea* was similarly cultured and observed: it is, the author states, easily recognized by macroscopic characters such as the mycelial mat and the characteristic colour.

A. L. S.

Fruit-body of Polystictus xanthopus Fr.—E. J. H. CORNER (*Ann. Bot.*, 1932, 46, 71–111, 17 text-figs., 1 pl.). *Polystictus* is a typical fungus common in Malaya; it has a thin, dry, rather tough pileus. Corner has studied it from the points of view of structure and development; he considers the hyphæ under four systems—skeletal, generative, binding, and mediate, the two latter types aseptate and thick-walled, but the binding hyphæ branched and interweaving, whereas the mediate are sparingly branched and longitudinal. The functions of each class of hyphæ are examined and described; the development is direct, so that the position of stem and pileus are at once determined by the direction of the apices of the first constructive hyphæ. The whole body reaches maturity in about two months. Hyphæ with thick walls form the chief xerophytic character; they provide rigidity and high impermeability to air, thus conserving the water in the narrow lumen.

A. L. S.

European Polyporaceæ.—ALBERT PILÁT ("Monographie der europäischen Polyporaceen mit besonderer Berücksichtigung ihrer Beziehungen zur Landwirtschaft," *Beih. Bot. Centralbl.*, 1931, 48, 404–36, 6 text-figs., 3 col. pls.). Pilát begins his monograph by a general account of Polyporaceæ, with special reference to their association with trees, etc., as being the cause of disease and also as to their giving rise to "mykorrhiza." A few are edible, but their value to mankind as foodstuffs is very small. He then gives a survey of the literature dealing with the European group. The systematic portion begins with the genus *Caloporus* Quélet p.p., species of which have previously been included in *Boletus* as well as in *Polyporus*. Six species of *Caloporus* are described for Europe. A. L. S.

A New Polypore.—ROGER HEIM ("Le *Phæolus Manihotis* sp. nov., parasite du manioc à Madagascar et considerations sur le genre *Phæolus* Pat.," *Ann. Crypt. Escot.*, 1931, 4, 175–89, 3 pls.). The new fungus was doing rather serious harm to the Manioc, and after examination was found to be a new species, *Phæolus Manihotis*. The author describes the conditions of its growth and gives a detailed account of its morphology and anatomy; it has also been found connected with other plants. The special characters are described—the colour of the exterior and of the flesh, also of the presence of a stipe. Much attention was given to the chemical properties which agreed more or less with those found in other members of the genus—the acid content and the coloration due to the application of alkalis. A description of the damage caused to the host plant is described and remedial treatment is suggested. A. L. S.

New Hymenomycetes.—ALBERT PILÁT ("Ueber eine neue *Hymenochaete*—Art aus dem sibirisch-mongolischen Gebirge Sajany: *Hymenochaete Murashinskyi* sp.n.," *Hedwigia*, 1932, 71, 322–27, 3 text-figs.). The species from China, described by Pilát, grew on Rhododendron. It is somewhat similar to *H. Mougeotii* but differs in microscopic details. "Ueber eine neue *Aleurodiscus*—Art. (*Aleurodiscus sajanensis* (Mur.) Pilát," *Tom cit.*, 328, 31, 3 text-figs.). This fungus grew also on Rhododendron in Eastern Asia, and was first described as a *Stereum*. Pilát has fully described these two fungi and justifies in each case the changes made in the systematy. A. L. S.

Fungi from the Caucasus.—R. SINGER ("Pilze aus dem Kaukasus II. Ein Beitrag zur Flora Swanetiens und einiger angrenzenden Täler," *Beih. Bot. Centralbl.*, 1931, 48, 513–542). Singer records 267 Basidiomycetes belonging to many genera. He has described a number of new species and varieties and in many cases has added descriptive notes. A. L. S.

Penetration of Hyphæ.—BURT JOHNSON ("Specificity to Penetration of the Epidermis of a Plant by the Hyphæ of a Pathogenic Fungus," *Amer. Journ. Bot.*, 1932, 19, 12–31, 1 text-fig., 1 pl.). The author set out to discover if fungi were able to penetrate plants other than their specific hosts. He experimented with *Colletotrichum circinans*, a parasite of the onion, *Allium Cepa*. He describes his methods of work in inoculating a series of plant-leaves from twenty-two different species. The fungus penetrated twenty of these plants and, though no disease was caused, the hyphæ within the point of penetration were viable after 3 days. The final evidence was that, under certain conditions, *C. circinans* is not limited in its host range to definite species of *Allium*. A. L. S.

Fungi of Iceland.—POUL LARSEN ("The Botany of Iceland, Vol. II. Part III. Fungi of Iceland," 1932, 451–607, 19 text-figs., 1 pl. (colour chart)). This

volume forms part of the "Botany of Iceland," edited by L. K. Rosenvinge and Eug. Warming. Larsen gives, in his Introduction, an account of previous investigators from the year 1765 onwards. The number recorded is now 802 species, including four species of Myxomycetes. A general account of the land and of the conditions is given, with special reference to environment as regards fungus growth. The largest forms, which elsewhere grow in woods, were found in the open, actual woods being absent in Iceland. The author concludes that a sufficiency of moisture is a main requirement of these fungi, and that is supplied by the prevailing dampness of the atmosphere; also they tend to grow in dense clusters and with shorter stalks. Larsen notes the unusual development of the "veil" covering the gills. Micromycetes are abundant, as the moist air keeps the decaying vegetation in a soft condition, and also because phanerogams have a "looser structure and feebler strengthening tissue" than in more southern lands. The immigration of fungi into Iceland is also discussed—whether they arrive with the host-plants or with seed.

A. L. S.

Seed-borne Parasites.—C. R. ORTON (*Agric. Exp. Stat. Coll. Agric. West Virginia Univ. Bull.*, 1931, 245, 1-47). The author has issued this paper on seed-borne rusts as a bibliography, and he has assembled the data from all available sources. In the Introduction he emphasizes the economic importance of the fungal parasites that are distributed by uncleansed seeds. He describes also the method of transportation by sclerotia, by a mummified seed, by parasitized seeds, or, mechanically, by spores on the surface of the seed. Bacteria and other organisms are often localized within the seed-coat, and thus bacteria, fungi, nematodes and insects may all be dispersed with the seeds. A long list of the diseases thus disseminated is given, with the names of the pathologists who have studied the diseases and reported on their possible origin.

A. L. S.

Mine-timber Decay.—REBECCA LURIE ("Some Organisms concerned in Mine-timber Decay," *Trans. Brit. Mycol. Soc.*, 1932, 16, 270-87, 4 text-figs., 2 pls.). Much damage is caused to mine timber by fungi, and the larger Basidiomycetes are generally considered the agents of disease. A research on the subject was undertaken by the author by examining decayed wood and allowing the fungi found on the timber to develop either on culture media or on sterilized blocks. Several fungi were thus isolated, the most frequent a Hyphomycete, *Bispora effusa*. The fungus is fully described; its presence on the wood is not always apparent. It destroys timber in a comparatively short time by penetrating the walls of the wood elements and attacking the middle lamellæ of the medullary rays. It was proved that a softening of wood to a pulpy consistency occurred in sap-wood of the seasoned and unseasoned wattle in six weeks.

A. L. S.

Dissemination of Disease.—W. C. SNYDER ("Seed Dissemination in *Fusarium* Wilt of Pea," *Phytopathology*, 1932, 22, 253-57). The writer set out to ascertain the means of dissemination of the *Fusarium* fungus as affecting the pea. Experiments were carried out by sowing seeds from wilted peas: the results were not conclusive as only few cases of disease occurred, though this means of transmission cannot be ruled out as never occurring.

A. L. S.

Fungi on Insects.—T. PETCH ("Notes on Entomogenous Fungi," *Trans. Brit. Mycol. Soc.*, 1932, 16, 209-45, 8 text-figs.). T. Petch continues his study of fungi on insects from all parts of the world. They belong to many different genera and many of them are new to science. In all cases Petch has given full descriptions with discussions on nomenclature; twenty-seven species are thus brought under

review. The last to be described, *Aspergillus depauperatus* n.sp., occurred abundantly on *Lepidosaphes Ulmi* at Hunstanton, Norfolk, and on *Aspidiotus* sp. at Nuwara Eliya, Ceylon. Cultures on Quaker oats confirmed the identity of this widely dispersed fungus. Most of the species described are from tropical lands.

A. L. S.

Fusion of Hyphæ.—A. M. DAVIDSON, ELEANOR S. DOWDING, and A. H. R. BULLER ("Hyphal Fusions in Dermatophytes," *Canad. Journ. Research*, 1932, 6, 1-20, 22 text-figs., 3 pls.). Buller had proved that hyphal fusions occurred in Ascomycetes, Basidiomycetes and *Fungi Imperfecti*, and that frequently they had no connection with sexual phenomena. The authors of this paper have investigated three types of Dermatophytes by means of cultures and have found that: (1) hyphæ of the same mycelium fuse readily with one another; (2) that hyphæ of the same species but of different origin also fuse readily; (3) that no fusions are formed between mycelia of different species. They demonstrate the method of using these facts, and they hold that species can thus be readily identified. The three species tested are fully described—as they appear on the skin of the patient and as they develop in culture.

A. L. S.

Diseases of Cereals.—T. A. RUSSEL ("Observations on Foot-rot Diseases of Cereals," *Trans. Brit. Mycol. Soc.* 1932, 16, 253-69, 1 pl.). The writer has found that little attention has hitherto been given to disease affecting the bases of cereals, termed foot-rot. It appears wherever cereals are grown and causes considerable loss. Several fungi are known to give rise to this disease and a research on the subject has been carried out by the author. His methods and results are recorded. He found in the course of his investigations that *Fusarium culmorum* was the most common parasite, attacking wheat, barley, and oats with equal severity. *Helminthosporium sativum*, also a frequent cause of trouble, was less injurious to barley than to wheat, and hardly affected oats. Russel suggests that good tillage and balanced manuring may do much to check the disease.

A. L. S.

Disease of Bajra.—H. CHAUDHURI ("*Sclerospora graminicola* on *Bajra*, *Pennisetum typhoideum*," *Phytopathology*, 1932, 22, 241-46, 3 text-figs.). In this disease the ears of the grass are affected and revert to a green leafy condition; it is of considerable economic importance, as it may entirely destroy all grain production. The disease was studied in the laboratory and oospores were germinated. Successful inoculations were made from the oospores, and Chaudhuri concludes that the disease is propagated through oospores in the soil. No conidial stage was found. The area affected by the disease was near Lahore.

A. L. S.

Disease of Flax.—HARMANNA A. DIDDEUS ("Untersuchungen über den Flachsbrand," *Phytopatholog. Zeitschr.*, 1932, 4, 291-313, 5 text-figs.). The flax disease here dealt with is widely spread in Western Europe. The symptoms are the backward condition of growth of young plants, the browning of the leaves, and the failure of the roots to develop. In many cases the crop is an entire failure. Diddleus gives an account of the examination of the diseased plants. It was found that a fungus, *Pythium megalacanthum*, was present, and research was directed towards the identification of that fungus as the origin of disease. Infection cultures were used to verify the diagnosis. There was some doubt as to whether the *Pythium* was that described as *P. megalacanthum*, but it was found that it agreed with the original description in most respects. Infections of other plants with the parasite were made, but all of them failed.

A. L. S.

Parasite of Mistletoe.—E. SILVER DOWDING ("Wallrothiella Arceuthobii of the Jack-pine Mistletoe," *Canad. Journ. Research*, 1931 5, 219-30, 21 text-figs., 2 pls.). *Arceuthobium*, the mistletoe attacked by the fungus, is allied to *Viscum* and *Loranthus* and parasitizes certain conifers, in the case described, *Pinus Banksiana*, the jack-pine. The fungus appears as a black stroma, more or less hemispherical in form, about 1 mm. in length and 1.5 mm. in width. It is one of the agencies which serve to restrict the spread of the damaging mistletoe, as it invades the seed of the mistletoe soon after pollination. Dowding has described fully the stages of growth up to the discharge of the ascospores, and suggests that further infection is probably secured by the insects which pollinate the flowers. The spores failed to germinate in artificial cultures, except in a decoction of *Arceuthobium*. Full details are given of the various cultures of the fungus.

A. L. S.

Disease of Cotton.—JOHN EHRLICH and FREDERICK A. WOLF ("Areolate Mildew of Cotton," *Phytopathology*, 1932, 22, 229-40, 4 text-figs.). The mildew of cotton is said to occur wherever the plant is cultivated, but the actual losses are slight, except on rare occasions and in limited localities. The disease has been given various names, but "areolate mildew" has been the most appropriate. It has been found in both the Eastern and Western Continents. It first attacks the leaves, which are soon covered with conidiophores and conidia. Experimental research has shown that there are three stages in the life history—the conidial stage known as *Ramularia areola* and also as *Cercospora Gossypii*; a later autumn stage, termed by the authors the *Status spermatiferus*, shows spots densely covered with "spermogonia"; finally, the perfect fruiting stage, *Mycosphaerella areola* n.sp., which appears in the spring on decaying leaves. The interconnection of these stages has been proved by cultures, though the evidence is not so strong as to connect the conidial stage with the *Mycosphaerella*, that stage being found only sparingly. It was, however, proved that isolations from conidia and from ascospores produced colonies of similar appearance. The perfect stage has not previously been described.

A. L. S.

Disease of Figs.—H. U. HANSEN and A. E. DAVEY ("Transmission of Smut and Molds in Figs," *Phytopathology*, 1932, 22, 247-52). Growers of figs have been seriously exercised by the development of various fungi—species of *Hormodendron*, *Aspergillus*, *Penicillium*, *Alternaria*, etc., a few yeasts and bacteria in the interior of the figs. They are carried thither by mites and thrips. The larger insects, *Carpophilus hemipterus* and *Drosophila ampelophila*, are not carriers of the cryptogamic flora. The authors describe *Aspergillus niger* as a "black, dusty type of smut," as termed in the title of the paper.

A. L. S.

Study of Fusarium.—L. H. LEONIAN ("The Pathogenicity and the Variability of *Fusarium moniliforme* from Corn," *Agric. Exp. Stat. Coll. Agric. West Virginia Univ. Bull.*, 1932, 248, 1-16, 6 text-figs.). The research undertaken by Leonian was intended to determine the causal agent in root-rot of corn. One of the first tests was to inoculate corn seedlings by removing the soil, making a wound in the plant, and covering the wound with the inoculum—rice culture in which the fungus was growing luxuriantly. Positive inoculations occurred but they were rare, proving that the fungus was only a weak pathogen. Comparatively low temperatures it was found were necessary for successful fungal inoculations, and it was also proved that pathogenicity occurred in cycles—successfully infecting at one time and failing at another. Also the strains were dissociated into many forms. One single-spore isolation produced fifty variants which differed not only

in their pathogenicity but also in morphological and physiological characters. Late planting of the corn to avoid cool, wet soil conditions seemed to be the best method of avoiding seedling losses caused by this fungus, as higher temperatures kept the pathogen in check and favoured a vigorous growth of the corn.

A. L. S.

Fusarium Disease of Cotton.—A. FIKRY ("Investigations on the Wilt Disease of Egyptian Cotton caused by Various Species of *Fusarium*," *Ann. Bot.*, 1932, 46, 29-120, 5 text-figs., 2 pls.). A thorough investigation of this Wilt has been made. Cotton culture is one of Egypt's most important industries, and it was estimated that in the Delta some 10 p.c. of loss was caused by the disease. It first appears as a yellowing of the foliage, called "Mosaic." A number of *Fusarium* species have been isolated from diseased plants—three species have been determined as direct agents of Wilt disease, *Fusarium orthoceras*, *F. vasinfectum* and *F. angustum*. Special attention was given to culture conditions, more especially to moisture and temperature. Attack by fungi occurred at all temperatures between 21-30° C., and infection was most severe in soil containing water amounting to 50-60 p.c. of its water-holding capacity. Many questions that arose in the course of the investigation are discussed, such as the presence and influence of acidity in the soil, organic salts, etc. The highest degree of attack was at pH 7.8-8.3.

A. L. S.

Rare Plant Diseases.—H. H. STIRRUP, ALEX. SMITH, J. REES, and H. WORMALD, *Trans. Brit. Mycol. Soc.*, 1932, 16, 308-10). Stirrup records the appearance of *Sclerotia rhizodes* Auersw. in England. It occurred on the ground in an old meadow in Derbyshire. Though the first appearance in England it is widely distributed in Europe, attacking meadow grasses. Alex. Smith and J. Rees found *Uredo Fuchsiae* growing on cuttings from a propagating house in Cardiff. It was first recorded from Guatemala. The origin of the Cardiff specimen is unknown. An account of *Botrytis cinerea* on apple stocks at East Malling Research Station is given by H. Wormald. It attacks fruits and very frequently the woody parts of fruit trees or bushes.

A. L. S.

Lichens.

British Lichens.—W. WATSON ("Lichenological Notes VI," *Journ. Bot.*, 1932, 70, 67-72). Watson gives valuable notes on British lichens. He has introduced to British botany the generic name *Hypogymnia* for the *Physodes* group of Parmeliæ. He has also taken *Cetraria chlorophylla* back to the genus *Platysma*. Zahlbruckner has listed that species as *Cetraria scutata*. One wants the reasons for and against any change in nomenclature. He has also changed *Lecidea bauschiana* to *Biatora*, a generic title generally regarded as sectional. A new species, *Lecidea scutellata*, is described. In a further contribution, *tom. cit.*, 96-100, a number of rare species are recorded, and numerous biological notes are given. The species *Allarthonia patellulata*, recorded from Ireland, has been found at Dolgelly. *Arthopyrenia Knightii* n.sp. from Birdlip, Gloucester, is described.

A. L. S.

New or Rare Lichens.—BOULY DE LESDAIN ("Notes lichénologiques No. XXV," *Bull. Soc. Bot. France*, 1931, 78, 726-31). A series of lichens, either species or varieties new to science, from widely different localities in the Eastern and Western Hemispheres. The author quotes as a generic designation the term *Parmularia*, used by Hue for a section of *Lecanora* to replace *Squamaria* already in existence as a genus of Phanerogams.

A. L. S.

Northern Lichens.—BERNT LYNGE ("Lichens Collected on the Norwegian Scientific Expedition to Franz Josef Land, 1920," Nr. 38, 1931, 1-31, 1 map, 2 pls.). Lynge gives a history of the few lichen collections from Franz Josef Land before his visit with a sketch of the land conditions. Those found were largely circum-polar species; he notes, however, a few from extreme east and west localities, though he decides that an eastern affinity is the more probable. He has listed sixty-nine species of his own collection. The best represented genera are *Lecidea*, *Lecanora*, and *Cetraria*. He collected only one *Cladonia*, *C. pyxidata*, though others have been reported by previous workers. A. L. S.

Greenland Lichens.—B. LYNGE and P. F. SCHOLANDER ("Lichens from North-east Greenland, Collected on the Norwegian Scientific Expeditions in 1929 and 1930," 1932, 1-116, 7 pls., 1 map, Oslo, Jacob Dybwads Bokhandel). In the Introduction to this comprehensive study B. Lynge gives a historical account of the lichens of Greenland, the first records dating back to the Second German Polar Expedition, 1870-71. Other workers followed, but none of their works is exhaustive, and Lynge considers that there is a very considerable lichen vegetation all round the north and north-east coast of Greenland. The special conditions met with in the region explored are discussed. There are no bird-cliffs north of the "Liverpool Coast," therefore nitrophilous species are rare or lacking, though on the rocks where birds rest there is a crowded growth. The universal presence of circum-polar lichens is also noted, though in East Greenland the dry climate is a specially limiting factor. The systematic part of the Paper presents a record of ninety-one different species, but that does not include crustaceous species, and Lynge reckons that probably the list of all lichens for Greenland would number about 315 different species. Some are new to science, and there are abundant and full notes of conditions, forms, etc. A. L. S.

Swedish Lichens.—GUNNAR NILSSON ("Zur Flechtenflora von Ångermanland," *Arkiv För. Bot.*, 1931, 24, n. 3, 1-122). Nilsson introduces his work on the lichens of the Province Ångermanland by a survey of the region which has a considerable sea-coast. The interior is of river valleys and hills up to 600 m. high or more. He discusses the geological formations, the climate, and the rainfall, as well as the duration of winter with its covering snow; the woods are largely composed of pines. Previous work in the region is related, and then the author gives an account of his own journeys in search of lichen vegetation. He presents a geographical arrangement, including a short list of eastern species and of coast species. The list, which includes all those already recorded, numbers 480 species, of these 129 are new for the province, some of them new to science. A. L. S.

Study of *Lecanora subfusca*.—A. H. MAGNUSSON ("Beiträge zur Systematik der Flechtengruppe *Lecanora subfusca*," *Göteborgs Bot. Trädgård*, 1932, 7, 65-87). Magnusson describes twenty-three species nearly related to *Lecanora subfusca*. He distinguishes them mainly on microscopic characters. He emphasizes particularly the occurrence and position of minute crystals within the thallus, and also the nature of the epithecium, the occurrence and character of the crystals and granules on it, and also the presence of colouring-matter in the Apothecium. He has replaced the Linnean species *L. subfusca* by *L. subfuscata* with a new diagnosis. A. L. S.

Moor-Lichens.—I. PASSIO ("Pohjois Satakunnan soiden jäkälistä. (Ueber die Flechten der Moore in Nord-Satakunta)," *Ann. Soc. Zool. Bot. Fenn.*, Vanamo, 1931, 15, 135-51). Finnish with German Summary. The writer describes the

different types of moor explored by him in West Finland. He states that lichens were most abundant in "Cope-Moors": of the forty moorland species twenty-six were definitely found there. Many of them are *Cladonia* spp., such as *C. alpestris*, *C. rangiferina*, etc., and lend a grey tinge to the vegetation. On the high moors lichens are less abundant, *Cladonia alpestris* being comparatively rare. It is also a factor in the matter of distribution that lichens are more abundant on *Calluna* moors, and, after the ground is cleared, lichens play a large part in renewing vegetation, *Biatora granulosa*, a quick-growing lichen, being one of the first to take possession of the ground. Species of the *Cladina* section of *Cladonia* are slow to appear, but other *Cladoniae*, *C. vacillaris*, *C. fimbriata*, etc., are well represented.

A. L. S.

Study of Cladonia.—FRAU KUSAN ("Ueber die angebliche *Cladonia pycnoclada* (Gaudich.) Nyl. in Jugoslawien, mit besonderer Berücksichtigung der nahestehenden Formen," *Hedwigia*, 1932, 72, 42-54). Frau Kusan gives a reasoned account of the *Cladini* section of *Cladonia*. She allows specific value to *Cladonia pycnoclada*, easily recognized by the almost transparent whiteness of the plant, but of several other species, *C. tenuis*, *C. mitis*, and *C. impeza*, she suggests that they are merely varieties of *C. sylvatica*. In proof of that she points out that there is no sufficient morphological or geographical distinction of these plants, the specific character alleged being chemical, or showing some difference in the orientation of the upper branchlets. A full account is given of each of these so-called species. The species *impeza* she looks upon as rather a collective variety of varying forms, placing under it ff. *laxinscula*, *condensata*, *spumosa*, and *portentosa*. All these have been placed by certain writers as species.

A. L. S.

American Cladoniae.—C. A. ROBBINS and S. F. BLAKE ("*Cladonia* in the District of Columbia and Vicinity," *Rhodora*, 1931, 33, 145-59, 3 pls.). An account is given of the general appearance of *Cladoniae* with explanations of the terms more generally used in descriptions. There are enumerated thirty-six species: twenty-three of these without restriction in habitat. Some were found only on the coastal plane and were rare, and several are true American species. A key has been provided which is comprehensive and descriptive, and the plates figure all or nearly all of the species listed.

A. L. S.

Rare Alpine Lichens.—ED. FREY ("*Parmelia centrifuga* (L.) Ach. und *P. incurva* (Pers.) Fries, in den Alpen," *Mitt. Naturf. Gesellsch. Bern*, 1930, lxx-vi). Both species, as stated by Frey, belong to the circumpolar lichen group and rarely occur in more southern climes, but were found in the Alps at an altitude of 1900-2000 m. The writer compares them with phanerogams of similar distribution, and he discusses the probability of their being relics of the glacial period.

A. L. S.

Study of Gyrophoræ.—M. CHOISY ("La classification des Gyrophoracés," *Bull. Soc. Roy. Belgique*, 1931, 64, 119-23, 4 text-figs.). Choisy considers unsatisfactory the classification of *Gyrophoræ* which has ranked them alongside of *Lecideaceæ* on the basis of a somewhat similar apothecial development. In many of the species the surface of the apothecial disc is gyrose owing to a broken succession of the fertile tissue. Some are without the gyrose sterile lines though agreeing otherwise with the general characters. He distinguishes them in groups as apothecia that are agyrose, umbonate, lacerate-gyrose, or *Dothidea*-like; the latter type of fruit-formation occurring in *Gr. torrefacta* and, according to Choisy's research and deductions, consisting of a stroma with perithecia-like fructifications.

He finds, however, a common measure of agreement in the pycnidia which are characterized by arthrosterigmata. Choisy therefore places them as an intermediary group between Pyrenolichenes near to *Dermatocarpon* and the Discomycetous lichens, also with arthrosterigmata such as occur in *Parmelia*, *Physcia*, and others.

A. L. S.

Study of leprose Thallus.—E. BACHMANN ("Der leprose Thallus einiger Krustenflechten," *Arch. f. Protistenk.*, 1931, 74, 262-96, 40 text-figs.). Bachmann begins his study by describing the association of hyphæ and gonidia in two species of *Lepraria*, *L. latebrarum* and *L. chlorina*, in both of which he finds that the hyphæ predominate, the algæ being mostly in small, isolated groups unrelated to hyphæ; solitary gonidia, however, are here and there clasped by the hyphæ. He then proceeds to the examination of *Lecidea uliginosa* and allied species. He has found that the hyphæ of these live on plant remains before they associate with the algæ and form distinct goniocysts—definite groups of gonidia surrounded by brownish hyphæ and taking various forms. In further stages there may be a sparse gonidial zone. Bachmann then describes the thallus creeping over masses of Cyanophycæ and sending down rootlike hyphæ into these masses. He points out finally that this type of thallus differs from the sorediate thallus in that the latter does not form goniocysts. He relates these forms of growth to the goniocysts of *Moriola*.

A. L. S.

Lichen Cephalodia.—ALBERT KAULE ("Die Cephalodien der Flechten," *Flora*, 1931, 126, 1-44, 16 text-figs.). The author has revised the whole question of Cephalodia formation. He gives a historical account of these bodies and of the views held by different writers; he then describes the different types of cephalodia and their development. He comes to the conclusion that they are gall formations. He gives special attention to the cephalodia of *Lobaria*, especially to the so-called *Dendriscoaulon* found on *L. amplissima*; at first the bodies associated with a blue-green alga are endotrophic, finally they burst through the upper cortex and form the well-known dark branching structures. Other cephalodia of *Lobaria* are developed near the upper surface of the thallus. In *L. pulmonaria* the earliest stage observed was a group of blue-green algæ just within the upper cortex. The green gonidia were pushed aside, and were destroyed by the advancing cephalodium. Hyphæ from the place of origin branch and gradually form a thick mantle round it. As to *Stereocaulon*, on the growing branches are to be found groups of green and blue-green algæ which are enveloped by hyphæ growing out from the podetia, as are also the groups of green gonidia that form the phyllocladia. A long list of the literature on the subject is given.

A. L. S.

Lichen Acids.—BR. SCHÜTT ("Flechtenstoffe in Cladonien (II.)," *Abhandl. Naturw. Verein zu Bremen*, 1931, 28, 183-92). Schütt has selected three species of *Cladonia* for re-examination, all of which contain acids of the fat series. In *Cladonia tenuis* he verified the findings of Hesse—d-Usnin acid and fumarprotocetrar acid. *Cl. polydactyla* contains sealing-wax yellow crystalline acids, termed polydactylin acid, and polydactyl acid, which have different formulæ and react differently in solutions. The third of the series, *Cl. degenerans*, contains a neutral substance, degenerantin, and two acids soluble in acetone, one of which is identical with the already known *degenerans* acid, the second with fumarprotocetrar acid previously found in several *Cladonia*.

A. L. S.

Coccomyxa gonidia.—OTTO JAAG ("Morphologische und physiologische Untersuchungen über die zur gattung *Coccomyxa* gehörenden Flechtengonidien,"

Verh. Schweiz. Nat. Ges., 1931, **112**, 331-32). Chodat in 1913 had determined *Coccomyxa* as the gonidial alga in *Solorina saccata* and *S. crocea*; Jaag has found the same alga in two other species, *S. bispora* and *S. octospora*, and he has determined the gonidia of *Peltigera aphthosa* and *P. venosa* to be also species of *Coccomyxa*. The same algal gonidium has been determined in *Icmadophila ericetorum*. Cultures were made of these gonidia, as also of a free-living *Coccomyxa* which proved to be identical with the *Coccomyxa* of *Solorina saccata*. It was further observed that these algae were polymorphic: in cultures they were invariably of thinner form than in nature, a character distinctive in purely mineral media, but still more so after an addition of glucose. The addition of pepton gave the same results, though if these substances were jointly added, the growth was seriously affected. In nature, in the poorest conditions, *Solorina*s possess gonidia which are well able to assimilate carbonic acid gas from the atmosphere, while, in the same conditions, cultured *Cladonia* gonidia when exposed are scarcely able to do so. Gonidia of *Parmelia*s pass easily to a saprophytic condition on culture media.

A. L. S.

Epiphytes on Lichens.—KURT GERBER ("Die epiphytische Verbreitung von Flechtenparasiten," *Archiv. f. Protistenkunde*, 1931, **74**, 471-89, 20 text-figs.). Gerber has directed his attention specially to those fungus-parasites that spread as epiphytes over the surface of the lichen thallus, but do not enter into symbiotic relationship with the gonidia either as parasites or as parasymbionts. He gives, as a first example, an epiphyte or *Parmelia omphalodes*, limited to a few hyphæ on the surface: the end cells are slightly larger than the others, perhaps indicating the formation of "gemmæ." A more advanced stage is depicted in a parasite on *Lecanora (Placodium) alphoplaca*. In that case there is a massing of the fungal cells again, indicating a beginning of fructification. More advanced was a fungus on *Parmelia encrusta* where a pycnidium was formed with spore formation. Gerber has described the fungus as *Phoma arachnoidea* n.sp. So far as observed this fungus is purely an epiphyte, but the underlying thallus is hard and broken and that may signify some penetration by the fungal hyphæ. The final example, also on *Parmelia encrusta*, is *Libertiella obscurior* n.sp. which spreads over the surface of the lichen and forms numerous pycnidia. A fungus on *Usnea Pseudophacidium* n.sp. is also fully described. It presents a clear case of parasymbiosis rather than parasitism; the penetrating hyphæ that mix with the lichen hyphæ are of larger build, and create no disturbance of the gonidia. The new species, the last with perithecia as well as pycnidia, are fully described.

A. L. S.

Mycetozoa.

Japanese Mycetozoa.—YOSHIKADZU EMOTO ("Die Myxomyceten der Südmandschürei," *Bot. Mag. Tokyo*, 1931, **45**, 229-34, 3 text-figs.). The Myxetozoon flora of the above region has not been hitherto investigated. Emoto now publishes eighteen species belonging to eleven genera. One species, *Physarum puniceum*, is determined by him as new to science; it is distinguished by the pale pink colour of the sporangia, the fine capillitium, and the somewhat large spores. A. L. S.

New Mycetozoa.—YOSHIKADZU EMOTO ("Ueber einige Myxomyceten," *tom. cit.*, 551-54, 1 pl., German and Japanese). Emoto describes *Physarum nasuense* n.sp. that grew on moss of a tree, *Cornus controversa*. A further note is published on *Clastoderma Debaryanum* var. *imperatoria*, supporting the previous description;

also a note on *Hemitrichia imperialis* which has been found again in better conditions, and the plasmodium of which has now been definitely determined as milk-white.
A. L. S.

Bacteria of Mycetozoa.—ALSUSHI WATANABE ("Über die Bedeutung der Nährbakterien für die Entwicklung der Myxomyceten-Plasmodien," *Bot. Mag. Bot. Soc. Japan*, 1932, **46**, 247-55, 1 text-fig.). The presence of bacteria in the plasmodium of Myxomycetes has long been known. Watanabe has made a study of the alliance by means of cultures. He explains the difficulties to be overcome, and gives details of the association of seventeen Myxomycetes with sixteen *Bacteria* species. The Myxomycetes studied varied in their relation to certain *Bacteria*, and a list is given of the species in order of preference. A further list is given of Myxomycetes in their order of preference for *Bacteria*. As a result it was found that most Myxomycetes showed a preference for *Bacterium Zopfii*, and it was definitely proved that *Didymium nigripes* var. *xanthopus* Lister reached its highest development when *Bacteria* were present.
A. L. S.

Colours of Mycetozoa.—TH. SOLACOLU ("Sur les matières colorantes de quelques Myxomycètes," *Le Botaniste*, 1932, **24**, 107-37, 2 pls.). The author reports the results of his chemical studies of colour in twenty-six species. He gives first a historical study of the investigation of the pigments. He finds that all the species are monochrome as regards their pigments, and that frequently from a white plasmodium are developed sporangia of yellow, red, brown, or black colours. In conclusion he states that, in general, the pigments are all soluble in sulphuric acid without much noticeable change of colour; with alkalies they give a red-purple or brownish-red reaction. All of these colours persist without change in air or light, and on sublimation they form crystals. They are all of anthracene character similar to colours of fungi and lichens. He argues from the result of his researches that there is a close bond between the Mycetozoa and fungi and lichens. Also he notes that anthracene pigments are associated with the vegetable world, and that their presence in animals is highly problematic.
A. L. S.

NOTICES OF NEW BOOKS.

Technical Instrument Bulletin.—Edited by A. G. FREWIN. Vol. 4, No. 1, March, 1932. 16 pp., 13 figs. Published gratis by the Emil Busch Optical Co., Ltd., Diamond House, Hatton Garden, London, E.C.1.

The Microscope.—By SIMON HENRY GAGE. Ultra-Violet Edition (15th). 1932. viii + 589 pp., 291 text-figs. Published by the Comstock Publishing Company, Ithaca, New York, U.S.A. Price \$4.00.

The Invertebrata.—A Manual for the Use of Students.—By L. A. BORRADAILE and F. A. PORTS; with chapters by L. E. S. EASTHAM and J. T. SAUNDERS. 1932. xiv + 645 pp., 458 text-figs. Published by the Cambridge University Press, Fetter Lane, London. Price 25s. net.

Principles of Soil Microbiology.—By SELMAN A. WAKSMAN. 2nd Edition, 1931. xxviii + 894 pp., 15 plates, 83 text-figs. Published by Baillière, Tindall & Cox, 7 & 8, Henrietta Street, Covent Garden, London, W.C.2. Price 52s. 6d. net.

Leitfaden der mikroskopisch-anatomischen Untersuchung pathologischer Objekte, des Blutes und des Zentralnervensystems.—By Dr. G. C. VAN WALSEM. 1932. 85 pp., 48 text-figs. Published by Verlag S. Hirzel, Königstrasse 2, Leipzig, Germany. Price RM.4.

Faune de France, Vol. 23. Diptères Chironomidæ IV.—(Orthocladiinæ, Corynoneurinæ, Clunioninæ, Diamesinæ).—By M. GOETGHEBUER. 1932. 204 pp., 315 text-figs. Published by Paul Lechevalier, 12, Rue de Tournon, Paris (VI^e). Price 45 fr.

Watson's Microscope Record.—No. 26. May, 1932. 24 pp., 21 figs. Published gratis by W. Watson & Sons, Ltd., 313, High Holborn, London, W.C.1.

Sulphur Bacteria. A Monograph.—By DAVID ELLIS, D.Sc. 1932. ix + 261 pp., 66 figs. Published by Longmans, Green & Co., Ltd., 39, Paternoster Row, London, E.C.4. Price 21s. net.

The sulphur bacteria form an interesting group of organisms, the cells of which contain globules of sulphur. They are widely distributed and play an important rôle in what may be termed the sulphur cycle in Nature, restoring to the soil in the form of sulphates much of the sulphur evolved from the putrefaction and decomposition of the dead remains of the higher animals and plants. The literature on the subject is very scattered and the author has sought to summarize it and make it available to English readers. Metabolism and artificial cultivation are first considered, and then the principles of classification. The various classifications that have been proposed are outlined, and the author then gives one of his own, and describes the various species. The concluding chapters deal with cell-structure, irritability and chemiotactic phenomena, ciliary movement, and the colouring-matter of the chromogenic forms. The final pages contain a full bibliography and indices. The author is to be congratulated on the completion of this Monograph, which forms a standard book on the subject. It is well produced and fully illustrated.

R. T. H.

Das Mikroskop und seine Anwendung.—By Dr. HERMANN HAGER, Ph.D. 14th Edition, 1932. Edited by Dr. FRIEDRICH TOBLER. 368 pp., 478 text-figs. Published by Julius Springer, Linkstrasse 23-24, Berlin, W.9, Germany. Price RM.16.50.

From either a theoretical or practical point of view this work on the microscope cannot be described as a comprehensive survey, as the instrumental part occupies only about a quarter of the subject-matter. The book opens with a concise section on microscopic optics. This is followed by sections dealing with the construction of the microscope and accessory parts, together with various forms of illuminators. The authors have confined themselves to describing the latest German models. The monocular microscope and binocular, comparison, and double oculars are adequately dealt with. Special attention is paid to the more recent forms of illuminators for use with opaque objects. There is also a brief account of the polarization microscope and of photomicrographic apparatus, whilst a section is devoted to the preparation of objects. Special mention may be made of the illustrations and diagrams, the latter being particularly instructive. The remainder, and by far the larger portion of the book, is concerned with objects selected from the animal and vegetable kingdoms. Here also a high standard has been attained in illustrating the subject-matter.

J. S.

Elementary Textile Microscopy.—By JOHN H. SKINKLE, S.B. With a Foreword by LOUIS A. OLNEY, D.Sc. 1930. 144 pp., 95 text-figs. Published by the Howes Publishing Company, 440, Fourth Avenue, New York, U.S.A. Price \$3.00.

The study of the microscopical structure of textiles, both the raw materials and the finished products, is becoming increasingly important. Perhaps in no other branch of industry is the microscope used so extensively, and in the study of textile fibres considerable skill and the use of the higher powers is called for. Imperfection in material is often only detectable by microscopy, and it is evident that a perfect finished product can only be produced if such imperfections are recognized at the earliest stage of manufacture. This book is intended not only for the student, but for all those who are really interested in textile work in all its implications. It is elementary in character, but covers enough ground to provide a sound basis for further investigation. The portion devoted to the microscope and its manipulation is clear enough to indicate principles and methods to a beginner. In some cases hardly enough is said, but a reader will realize that reference to other more exhaustive treatises is advisable if serious study is intended. That portion dealing with the examination of fibres and their preparation as microscopic objects is good; obviously the writer is dealing with the subject from his own experience. The book concludes with a series of exercises or laboratory experiments. These are well selected; the student will learn much from them. The impression throughout is that this is a good elementary treatise; its limitations and imperfections arise almost entirely from the author's attempt to cover so much ground within the compass of such a small book. J. E. B.

Practical Microscopy.—By L. C. MARTIN, D.Sc., and B. K. JOHNSON, F.R.M.S. 1931. 116 pp., 88 figs., 10 plates. Published by Blackie & Son, Ltd., 50, Old Bailey, London, E.C.4. Price 3s. 6d. net.

This little work is a brief summary in thirteen chapters of modern procedure in practical microscopy, and is written with a view to giving the reader a better understanding of the instrument and its components, assuming that he has some practical knowledge and experience, and to enable him to apply in practice current technique in the setting up and manipulation of the instrument.

The first chapter is devoted to magnification and micrometric measurements, and in subsequent chapters the stand and mechanical parts, the optical elements, and methods of illumination are briefly dealt with. A useful chapter on the preparation and mounting of specimens is also included, while the concluding chapters deal with the interpretation of the microscopic image and ultra-microscopy. A useful index is added.

It may be doubted whether the effort to compress into little more than a hundred small pages the whole subject of practical microscopy, including ultra-microscopy, is practicable, but the authors are to be congratulated upon their endeavour.

Microscopic Determination of the Ore Minerals.—By M. N. SHORT. 1931. vii + 204 pp., 11 plates, 16 text-figs. Published by United States Geological Survey, as Bulletin 825. Sold by Superintendent of Documents, Washington, D.C., U.S.A. Price 60 cents.

This book presents a collection of the latest available data on microscopic methods as applied to ore-mineral determination, both in polished sections by reflected light, and in microchemical treatment of powders by transmitted light. The book is not an exhaustive treatise on either polished section studies or micro-chemistry, but confines itself strictly to the field indicated by its title.

The first half of the book is devoted to the study of polished sections of ores. Part I treats of preparation and mounting of specimens, reviewing in some detail the technique of procedure at several institutions. The section on photography is brief but excellent, and is well illustrated.

Part II, entitled "Physical Properties," deals with the actual microscopic examination of polished ores. Special researches in colour, hardness, and electrical conductivity are reviewed. Detailed attention is given to the examination of opaque minerals in polarized light. Apparatus for these determinations is adequately illustrated.

Part III deals with etch reactions on the polished surfaces, and presents detailed determinative tables based on physical characteristics and etching tests.

Part IV, constituting about the second half of the book, deals with microchemical methods for the detection of the elements present in the ore minerals. The apparatus and procedure are described briefly but clearly, and well illustrated. The colour-plates, showing precipitated compounds of copper, cobalt, antimony, lead, silver, and gold, as formed under the microscope, are of exceptional quality. Tests are given also for compounds of the common metals, zinc, nickel, iron, tin, mercury, and manganese, and for the semi-metals arsenic, bismuth, tellurium, and selenium. The non-metallic elements, except sulphur, are not considered.

The author has exercised great discrimination in the selection of earlier published material. Apparently he has taken nothing for granted, but has included only those tests whose usefulness he has proved. A selected list of seventeen liquid and twelve solid reagents includes all substances necessary for making the microchemical tests; eight other liquids are used for etching the polished sections.

Within its limited field, the reviewer considers this Bulletin to be the best book that has appeared in English. The critical care that the author has given to every phase of his subject is so pleasing that one wishes that the scope of the treatment had been more extensive.

S. B. T.

The Microscopic Characters of Artificial Solid Substances or Artificial Minerals.—By A. N. WINCHELL. With a chapter on the Universal Stage, by R. C. EMMONS. 2nd Edition, 1931. xvii + 403 pp., 311 text-figs. Published by John Wiley & Sons, Inc., New York; and Chapman & Hall, Ltd., 11, Henrietta Street, Covent Garden, London, W.C.2. Price 31s. net.

The first edition was published in 1927 as No. 4 of the University of Wisconsin Studies in Science. In this, the second edition, the author has added some useful information from his "Elements of Optical Mineralogy," Part I, thus making the work more complete, especially as Professor Emons has also added a chapter on his modification of Fedoroff's universal stage.

The book is divided into three parts. Part I, consisting of eight chapters, treats of the principles and methods of optical mineralogy. Part II consists of eleven chapters, and describes the properties of artificial inorganic solids and minerals. This has been revised and brought up to date. The subject-matter of this portion of the book has been compiled for the most part from published information. The density and refractive indices are given for each substance, the latter being given for C, D, and F lines, or, in some cases, for lithium, sodium, and thallium light. This enables the microscopist to take advantage of the double-variation method in his determinations. For many of the substances mentioned the author has given other useful information, such as further optical properties, influence of impurities on refractive indices, crystal system, chemical properties, and method of preparation. In some cases the influence of change in composition

on the optical properties is illustrated by a graph. This portion of the book closes with twelve pages devoted to the optical properties of the siliceous glasses, and includes a few types of natural glasses. Part III forms a supplement to information given in Part II. In this portion the substances are listed in two tables. Table I contains the isotropic and Table II the anisotropic substances. In each table the arrangement is that of increasing refractive index for sodium light. The second column gives dispersion, the third chemical formulæ, followed by crystal system, cleavage, etc. The last column gives the page in Part II where further information is available.

An index to the whole book is provided. This work should prove useful to those who, like the reviewer, are engaged on the examination of materials which have been intentionally subjected to high temperatures. The binding is strong, and the paper and printing good, so that there is no danger of pages coming adrift due to constant use.

W. H.

Vision and Colour Vision.—By R. A. HOUSTOUN, M.A., D.Sc. 1932. vii + 238 pp., 102 text-figs. Published by Longmans, Green & Co., Ltd., 39, Paternoster Row, London, E.C.4. Price 15s. net.

The subject is treated in a masterly manner, giving the facts ascertained and theories advanced from the time of Newton and Young.

The author discusses the work of others up to date, and modestly indicates his own researches.

It is improbable that this intricate subject will be elucidated without further knowledge as to the precise nature of light and the physical characteristics of sensation. It can only be taken as a stepping-stone towards the ultimate solution of the problems. For instance, the suggested explanation of the acuity of vision does not appear to give as high a degree of resolution as is found in practice, unless the size of the rods and cones, as generally stated, is incorrect. The mathematical objection to the Young-Helmholtz theory of colour perception exhibits an interesting method of dealing with a hypothesis by means of abstract principles.

Perusal of the book suggests to the microscopist that improved technique in cutting thinner sections of the retina and in new methods of staining might contribute to the data required by the investigator.

Lehrbuch der Mikrophotographie und Mikroprojektion.—By Dr. med. KURT LAUBENHEIMER. 2nd Edition, 1931. xii + 272 pp., 187 text-figs., and 8 tables of photomicrographs. Published by Urban & Schwarzenberg, Berlin. Price RM.18.

A very complete book dealing with the subject of "photomicrography," the term universally applied in England to the photography of microscopic objects. There are few references to anything but German apparatus, most of the illustrations being taken from Leitz or Zeiss catalogues. There is much justification for this, as it must be admitted that English manufacturers have not given adequate attention to such appliances. Each part of the microscope, both optical and mechanical, is fully described, and sufficient is presented of the theoretical aspect to make the book of value to those interested. The drawings and diagrams of optical paths are particularly good, thus helping to a clear presentation of a subject that is often difficult to practical microscopists. On the subject of illumination all modern appliances are described adequately, together with methods of use. An extensive bibliography is appended, and the illustrations at the end of the book are of very high quality. As examples of photo-reproduction they could hardly be excelled.

J. E. B.

PROCEEDINGS OF THE SOCIETY.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD IN THE HASTINGS HALL, BRITISH MEDICAL ASSOCIATION HOUSE, TAVISTOCK SQUARE, LONDON, W.C.1, ON WEDNESDAY, MARCH 16TH, 1932, AT 5.30 P.M., MR. CONRAD BECK, C.B.E., PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the President.

New Fellow.—The following candidate was balloted for and duly elected an Ordinary Fellow of the Society :—

Harold Keith Box, Ph.D., Toronto.

Nomination Certificates in favour of the following candidates were read for the first time, and directed to be suspended in the Rooms of the Society in the usual manner :—

John Lewis Bremer, M.D., Boston.

Frederic Thomas Lewis, A.M., M.D., Boston.

Paul K. Losch, D.D.S., Boston.

Harold Lorraine Weatherford, M.A., Ph.D., Boston.

The Death was reported of :—

F. C. Dumat. Elected 1910.

A vote of condolence with the relatives was passed.

Donations were reported from :—

Messrs. Longmans, Green & Co., Ltd.—

“Sulphur Bacteria. A Monograph.” By David Ellis.

Prof. A. Gandolfi Hornyold, F.R.M.S.—

4 Zeiss compensating eyepieces, $\times 2$, $\times 6$, $\times 8$, $\times 12$.

5 Zeiss apochromatic objectives, 16 mm., 8 mm., 4 mm., 2 mm., 1.5 mm.

Mr. S. C. Akehurst, F.R.M.S.—

Micro slide of *Eudorina elegans* (forma *globosa*).

Dr. Syed Hedayetullah, F.R.M.S.—

Ten pounds.

Votes of thanks were accorded to the donors.

Signing the Roll.—The following gentlemen present, having subscribed their signatures to the Roll of Fellowship, were received by the President and admitted as Fellows of the Society :—

Mr. Thomas S. Beardsmore.
Mr. N. Ingram Hendey.
Mr. A. E. Clarence Smith.

Papers.—The following communications were read and discussed :—

Dr. Wilfrid Marshall, M.A., B.Sc., M.D.—

“ The Influence of Refractive Index on Mounting Media.”
(Communicated by Mr. W. E. Watson Baker, F.R.M.S.)

Mr. Thomas S. Beardsmore, F.R.M.S.—

“ The Lines of Fracture in *Surirella gemma*, with Observations on Substage Illumination.”

Votes of thanks were accorded to the authors of the foregoing communications, and to Mr. W. E. Watson Baker.

Announcement.—The President announced that the Biological Section would meet in the Pillar Room on Wednesday, April 6th, 1932, at 6 p.m.

The proceedings then terminated.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD IN THE HASTINGS HALL, BRITISH MEDICAL ASSOCIATION HOUSE, TAVISTOCK SQUARE, LONDON, W.C.1, ON WEDNESDAY, APRIL 20TH, 1932, AT 4 P.M., MR. CONRAD BECK, C.B.E., PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the President.

Nomination Certificate in favour of the following candidate was read for the first time, and directed to be suspended in the Rooms of the Society in the usual manner :—

Otto Langer, Dorking.

Donations were reported from :—

Messrs. Longmans, Green & Co., Ltd.—

“ Vision and Colour Vision.” By R. A. Houstoun.

Messrs. Comstock Publishing Company—

“ The Microscope.” Ultra-Violet Edition (15th). By S. H. Gage.

Votes of thanks were accorded to the donors.

Exhibits.—The following gentlemen exhibited specimens in connection with their contributions to the ensuing Discussion:—Mr. J. E. Barnard, Dr. S. P. Bedson, Capt. S. R. Douglas, Dr. W. J. Elford, Dr. G. M. Findlay, Prof. E. Hindle, Dr. C. C. Hurst, Mr. B. K. Johnson, and Prof. J. C. G. Ledingham.

DISCUSSION ON THE MICROSCOPY OF THE FILTERABLE VIRUSES.

MR. CONRAD BECK, C.B.E., P.R.M.S.—We are here to-night to discuss the Microscopy of the Filterable Viruses.

The latest development of microscopy depends for its success on the use of dark-ground illumination and the use of ultra-violet light.

In opening the discussion, I will call your attention to the danger of assuming that what is seen under the microscope is a correct representation of the object being examined. No optical instrument forms an image that is a perfect representation of the object. Errors in the design and construction, errors due to bad illumination and technique may be overcome, but errors due to the diffraction of light cannot be overcome, however perfect the instrument. They can only be modified, and it is necessary to investigate this error due to diffraction if one is to interpret correctly the images seen or photographed by the high-power microscope or to appreciate the advantage gained by the use of ultra-violet light.

The errors produced by diffraction are very small, so that when examining objects through field-glasses and small telescopes, or when photographing with ordinary cameras where the images are not highly magnified, the errors are imperceptible and the images may be taken as correct representations; but the high-power microscope is striving to obtain the highest magnification obtainable, and the diffraction error is not only perceptible but entirely destroys the clearness of the image if the magnification is increased beyond a certain limit.

If any microscopist will provide himself with a piece of silvered glass he will find that if illuminated with a powerful light from a substage condenser and examined with an object-glass, it has a large number of fine holes which will show as bright specks on a dark field—some are so small that they show as specks without any apparent size or shape. They are so small that they may for practical purposes be considered as mathematical points. Now introduce an iris diaphragm behind the object-glass. When the iris is shut down and reduced in size, the numerical aperture of the object-glass is reduced and the images of these points will appear as small circular discs surrounded by one or two faint rings of light. When the aperture is further reduced in size, the circular discs will become larger, and if the silver plate be removed and an ordinary object inserted in its place, all parts of the object will be fuzzy and indistinct—specks of dust in the object appear as circular discs, lines in the object (which are, in fact, rows of points touching each other) appear as rows of overlapping discs, and form a band. Every piece of structure will also be composed of a mass of overlapping discs and small objects so close together that their discs in the image overlap to a considerable extent and will not be seen as separate elements. Every image seen under such conditions will be larger than the object it depicts by the diameter of this diffraction disc. When fine measurements of microscopic objects are made it must be ascertained what is the diameter of that diffraction disc of a point, and that amount must be deducted from the measured size of the image. The size of this diffraction disc becomes the deciding factor which determines the size of objects and the fineness of detail that can be seen with any optical instrument. In most instruments it is

so small that it appears to be a point, its presence does not interfere with the apparent sharpness of the image. It is, however, a defect that is always present, though generally imperceptible. The size varies with the aperture of the lens compared with the magnification of the image. The experiment described shows how reducing the aperture of a microscopic object-glass with an iris diaphragm increases the size of the disc. With the same object-glass, increasing the magnifying power by a higher eyepiece also increases the size of the disc, and to reduce the size of this disc to a size that will not interfere with the sharpness of the image when the magnification has been increased, the numerical aperture of the object-glass must be increased by opening the iris diaphragm.

Thus, every object-glass must have a higher numerical aperture as the power goes up—each power object-glass should have a numerical aperture of such a size that the size of the diffraction disc is imperceptible. This is done with all powers up to $\frac{1}{2}$ inch, but there is a limit to the numerical aperture obtainable and therefore to the magnification that can be used with advantage, and that forms a limit to what can be clearly seen with the microscope. For objects which are not immersed in fluid or a mounting medium, the highest possible numerical aperture is 1 N.A.—for objects mounted in an aqueous solution, 1.33 N.A.

If, however, a further experiment is made with the diffraction discs before mentioned, the iris diaphragm being cut down to show a fairly large diffraction disc, a red screen, such as Wratten's filter, placed in front of the illuminant, will show a diffraction disc nearly double the size of that shown if a blue filter is used. That is to say, the size of the diffraction disc is dependent not only on the numerical aperture, but also on the wave-length of the light used as an illuminant.

The ultra-violet light employed in Mr. Barnard's ultra-violet microscope is about half the wave-length of blue-green visible light and therefore produces diffraction discs half the size obtainable with the ordinary microscope. It is equivalent to doubling the numerical aperture, and it shows detail twice as fine as can be seen with visible light.

The method of finding the diameter of that disc is not so simple. We have to thank the ceaseless industry of those who are sometimes called the Diatom Dotters for getting us this information. They came first, the theory to explain it came later, and is even now not universally accepted. The Diatom Dotters have determined that with a particular numerical aperture and a particular wave-length of light a certain number of lines or dots to the inch can be seen as separate lines or dots. They are said to be resolved, and this power is termed the resolution of the microscope. If the image of a point is a disc, and if two points in the object are at such a distance apart that they can be just distinguished, it means that their disc images do not overlap to any great extent.

The importance of the numerical value of this resolution is twofold. Suppose it is 100,000 lines to the inch, it means that two elements $\frac{1}{100,000}$ inch apart can be distinguished as separate elements, but also, and perhaps of even greater importance, every line, point, or element of structure in the object will appear in the image $\frac{1}{100,000}$ inch larger or thicker than it actually is, and this fact must always be considered in interpreting a high-power microscopic image.

The diffraction disc requires a little further consideration. It is more intense in the centre and fades off towards the edge. It is surrounded by faint rings. If the illumination is exceedingly brilliant the first ring may be visible. It may give the appearance of a marginal line surrounding a small object, or it may produce an indistinct image. It is probable that most of the membranes or envelopes previously alleged to exist round the smaller bacilli were due to the first diffraction ring being shown, and do not actually exist. If a photograph is taken very slightly

out of focus it renders this diffraction ring much brighter and intensifies the appearance.

But if we confine our attention to the diffraction disc, its intensity may be indicated by a diagram in which the height of the white space represents its high intensity in the centre, fading to nothing around its margin. If two such discs overlap by half the diameter of the black ring around them, it is generally taken that they can be resolved by the eye, and this agrees fairly well with experience. The measure of the visual resolution is a convenient figure. With a numerical aperture of 1 N.A., using blue-green light as an illuminant, it is about $\frac{1}{100000}$ inch, or with a N.A. of 1.3, $\frac{1}{130000}$ inch, and so on. No objects mounted in water or an aqueous solution permit of a higher numerical aperture than 1.33, which gives a resolution of about $\frac{1}{130000}$ inch, or with blue light, say $\frac{1}{140000}$ inch, and that puts a limit to what can be resolved with the ordinary microscope. If, however, ultra-violet light 2750 Å.U. is used, the wave-length of the light is so much shorter that with the same numerical aperture a resolution of about $\frac{1}{280000}$ inch is obtained, and separate elements as close together as this can be distinguished. If at some future time a shorter wave-length still can be used, it may be further increased.

Now that Mr. Barnard's technique and apparatus has made photography with ultra-violet light as certain and reliable as ordinary photo-micrography and that hundreds of photographs are regularly taken in his laboratory with scarcely a failure, a curious fact has been discovered. Under certain circumstances the resolution appears to be more than theory and practice have hitherto suggested. It may perhaps be due to the well-known property of a photograph showing in some cases what the eye cannot see. Stars which emit light too feeble to affect the eye can be readily photographed, and if an under-exposed photograph be taken and the only portion of the diffraction disc brilliant enough to affect the plate may be the small central part, all the rest of the diffraction disc being too faint to photograph, the image of a diffraction disc would then be smaller than that seen by the eye, and for practical purposes this would reduce the diameter of the diffraction disc and increase the resolution. There is some evidence from spectroscopic work to confirm this suggestion. It is said that double spectroscopic lines can be shown as two with an under-exposed photograph, but cannot be seen as two with a well-exposed plate.

There is, however, another important requirement in high-power microscopy which is generally called visibility. Essentially this is a question of the contrast either in light and shade or in colour between the object and its background, or between different elements of its structure. Staining methods are efficient in this respect as, especially with the use of colour screens, satisfactory contrast can be obtained.

For cases where staining is not desirable or where, as in the case of living organisms, it cannot be adopted, the question of visibility requires careful attention. Unless the contrast is considerable, it is very difficult to see or photograph small objects, and where transparent or semi-transparent objects are observed, their images are largely composed of a series of shadows—shadows cast by portions of the structure. These are extremely difficult to interpret, because the nature of these shadows depends on the direction of the illumination.

A few experiments in the illumination of an air-bubble in water demonstrate the considerable alteration in the appearance of the images caused by alteration in the illumination.

Minute objects, whether transparent or opaque, can only be seen with great difficulty against a bright background. The same objects if illuminated with a

powerful light against a black background become clearly visible, due to the increased contrast and lack of irradiation. The interpretation is also less difficult, because the images are formed by light reflected by the elements of their structure, and this is the class of image we are in the habit of interpreting when we view natural objects with the eye.

A line or point, no matter how small, can be seen illuminated against a black background if it reflects sufficient light. True it will be larger than it should be by the amount of the resolution given by the N.A. and wave-length of light; but by visibility alone, fine dividing lines, membranes, and a great deal of detail can be photographed that is well beyond the limit of resolution, and they would not be visible on a bright background by transmitted light. A gossamer cobweb which is invisible against a bright sky is readily seen in the sunlight against a dark background. It requires dark-ground illumination to take advantage of this method. At a time when certain schools of microscopists considered that there was a theoretical reason why dark-ground illumination was useless for high-power microscopy, Mr. Barnard was regularly employing it with object-glasses of high numerical aperture, and demonstrated that the resolution was equal and the visibility better than that obtained with transmitted illumination.

The combination of the use of ultra-violet light with dark-ground illumination has at least doubled the power available with the microscope, and the technique which has produced the results which we shall see on the screen will be described by Mr. Barnard. We invite a full discussion on the subject.

MR. J. E. BARNARD, F.R.S.—During the last three years two discussions on the virus problem have taken place, one at the Royal Society and the later one at the British Association meeting in September last. Both in the material presented and in the personnel there was considerable resemblance, and yet to me, as an observer, there was a marked difference in outlook. At the later meeting it seemed to be accepted that a virus was probably a small organism, differing chiefly in size—although it might have other physical differences—from the larger and well-known bacteria. If that is the case it is obvious that this subject comes definitely within the province of a microscopical society and justifies the setting of this discussion. My own work has for many years been carried on with a view to increasing the efficiency of the microscope, mainly by the use of light of shorter wave-length than that commonly used to form a visible image. If there is any justification for persistent effort in this direction, some problem would need to be found as a test. The virus problem does afford such an opportunity and I accepted it without hesitation, although it obviously involved a great deal of research work not by any means microscopical. There are three main propositions governing my own plan of attack:

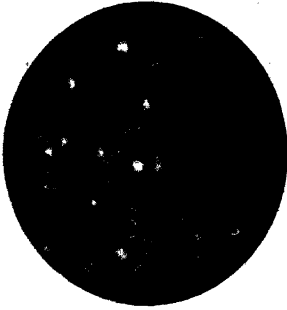
- (1) That observation of small organisms can best be effected with living material. Advantage can then be taken of morphological and physical differences that are obliterated in a post-mortem examination.

- (2) That to obtain the necessary microscopical resolution visibility must be secured, and that with small elements of structure lying in one plane and separated one from another by a distance equal to or greater than the resolution limits, this is best attained by a dark-ground illumination method.

- (3) That the necessary combination of visibility and resolving power is only to be secured by the use of light of short wave-length, the wave-length necessary being dependent on the size of the organism or body to be observed.

For the purposes of this discussion it may be of interest to consider two types of object, and to these I propose to limit my remarks. The accompanying photo-

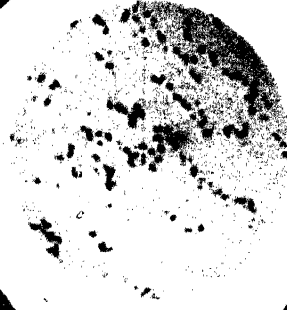
graphs will serve to demonstrate the points at issue and they do cover some of the ground on which there is apparently some misconception. Our President has already so efficiently dealt with the purely physical side of image formation in the microscope that no further remarks on this aspect are needed. To enable you to visualize the scale on which most of my illustrations are shown, reference may be made to a dark-ground ultra-violet photograph of *Chr. prodigiosum* (Fig. 1, $\times 3200$). For the information of those not conversant with bacteriological method, this organism is sometimes used to test the porosity of filters, its size is fairly uniform in artificial culture, and it is among the smaller of the ordinary bacteria. In a very general sense it is near the resolution limits of the ordinary microscope, and whether an organism smaller than this is a "virus" or not is largely a matter of terminology. It is not easy to find an object which is comparable in size to that assigned to some viruses, ranging perhaps from 70 to 200 μ . It is possible, however, to deposit carbon from a smoky flame on a cover-glass, and four photographs are shown of such objects. These particles range from about 50 to 150 μ in diameter, and they happen to have arranged themselves, as organisms often do, in chains or small groups. In Fig. 2 the result of photographing such objects in visible light, under the best obtainable optical conditions, is shown. The images consist of diffusion discs, the size of which is dependent on the resolving power of the objective used, not on its magnification. Another factor governing the size of image is the exposure given in taking the photograph, the longer the exposure the larger the image, although the character of the image is unaltered. The only result of varying magnification is to alter the separation of the images, increased amplification has no other significant effect. Illuminating by transmitted light is possible with such an object, as it is sufficiently opaque to secure visibility, but it has no effect on resolution, as Fig. 3 shows. Figs. 2 and 3 ($\times 2500$) are strictly comparable; they are photographs in visible light of the same field under dark-ground and transmitted light respectively. Fig. 4 represents a similar object, the particles having the same range of sizes, although they are not the same field, photographed by transmitted ultra-violet light. The resolving power of the optical system and the wave-length of the light used should result in adequate resolution, but actually it is not satisfactory owing to lack of contrast. In Fig. 5 ultra-violet dark-ground illumination has resulted in perfect resolution. The particles are seen in their actual form and size, and although the magnification ($\times 3200$) is greater than that shown in Fig. 2, the size of image is much smaller, as indeed it should be. An example of a "virus" body is vaccinia, of interest because it can be made visible by certain staining methods, although such objects cannot be identified with any certainty by means of the ordinary microscope. The staining methods used increase the apparent size of the object so that it is near to or within the resolution limits in visible light. Fig. 6 shows the so-called Paschen bodies, from a preparation stained by Paschen and photographed in visible light ($\times 2000$), which are fairly well defined although there is nothing characteristic about the image. It is assumed to be the significant organism because other experimental evidence is suggestive; on microscopical grounds identification would be difficult, if not impossible. Fig. 7 is a stained preparation from an uninoculated serum-broth tube, from which it will be appreciated that there is a great similarity in the appearance of the image to that shown in Fig. 6, although the medium itself was bacteriologically sterile. Fig. 8 is a dark-ground ultra-violet photograph of living, untreated vaccinia virus concentrated by filtration from an emulsion of infected rabbit testicle: The image so obtained does suggest the appearance of an organism, and all control experiments that have so far been done are confirmatory of such a hypothesis. These few examples suggest that



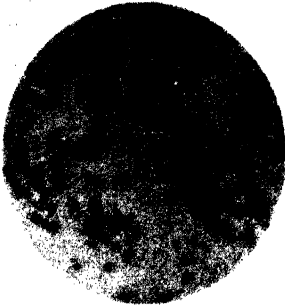
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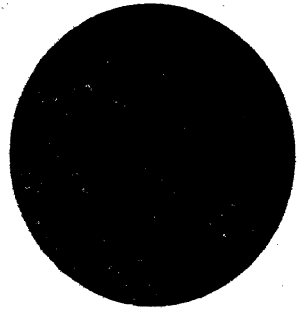
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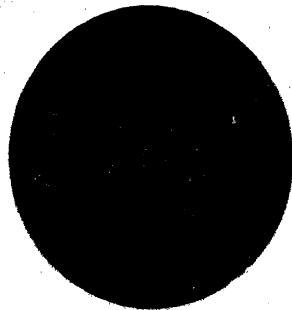
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8

the nature of the virus problem is not likely to be determined by means of the ordinary microscope employing visible light.

It is recognized that the microscope alone cannot, in any case, provide all the evidence necessary, but taken in conjunction with other experimental evidence it will perhaps be the most important link in the chain. Bacteriologists might try to visualize the position to-day if no microscope were available for the study of what are known as ordinary bacteria. That appears to me to be the virus problem as it stands at present—bacteriology without a microscope. Perhaps that is all it is.

PROF. J. C. G. LEDINGHAM, F.R.S.—Prof. Ledingham said that the microscopy of filterable viruses was a subject practically limited, at present, at any rate, to the problem of cell-inclusions and the so-called elementary bodies whose size was round about the limit of microscopic vision. So far as cell-inclusions were concerned, whether of the cytoplasmic or intranuclear type, there was no doubt that their presence was a most valuable guide to the existence of particular virus infections and there was no good evidence that they could be produced by artificial non-specific means. On the other hand, with the exception of the Bollinger body in fowlpox, the Molluscum body in *Molluscum contagiosum*, and the Marchal body in ectromelia, it was, he thought, correct to say that in no instance was there any precise knowledge of the composition and nature of these bodies.

To take the Bollinger body as a type of an explained inclusion, everything pointed to the probability that the Borrel bodies invaded the epithelial cell in which they succeeded in growing to larger or smaller aggregations. The lipoprotein coat which finally surrounded the Bollinger inclusion was most probably secreted by the invaded cell, though it might be a defence product of the Borrel bodies themselves. With regard to the elementary bodies which were known and studied by staining and other methods in vaccinia, fowlpox, ectromelia, and psittacosis, there was now a great deal of evidence of an experimental nature, particularly perhaps in vaccinia, fowlpox, and psittacosis, that they represented the actual infective agents in these diseases. The speaker had taken the opportunity at the meeting of demonstrating these bodies in vaccinia and fowlpox lesions and had also shown preparations illustrating the composition of the Bollinger body.

Referring to Mr. Barnard's observations on Paschen bodies by ultra-violet light photography and his previous observations on the elementary bodies in ectromelia, he said it was gratifying to know that the bodies discovered by Paschen in 1906, which were so readily demonstrated by staining methods and, in the mass, so easily differentiated from other particulate matter that no experienced microscopist could ignore them, were, in Mr. Barnard's opinion, living micro-organisms. This conclusion was reached by Mr. Barnard simply on the strength of their appearance when examined by ultra-violet light and especially by their possession of a cell-wall. The speaker doubted whether possession of a cell-wall, even if a genuine cell-wall, justified the inference drawn by Mr. Barnard where such a minute organism was concerned, and he pointed out that Mr. Barnard himself appeared to be uncertain whether purely optical effects could be excluded. The speaker was satisfied that improved visual methods by use of shorter rays enabled a finer resolution of the elementary body in its naked state, but that their application was limited practically to those few viruses at present known to be associated with elementary bodies otherwise readily differentiated by staining methods. Visual methods alone, however, were of little or no value nowadays in establishing disease relationship.

During the past five months he had been studying the filterable "viruses," so-called, of Pleuropneumonia and Agalactia. It was said that the pleuropneumonia virus was the only virus capable of cultivation in artificial media, such as serum broth. It was certainly filterable through certain grades of candle filters, but was it a virus in the ordinarily accepted sense? His observations led him to think that the pleuropneumonia organism was a bacterium (myxobacterium perhaps), or a fungus which possessed a filterable phase, or rather which contained elements of minute size capable of reproducing the organism.

The morphology of this organism had a curious and, in some ways, inexplicable history. Bordet in 1910, using the Giemsa stain, got excellent pictures of the constituent elements and noted especially their vibrionic or spirillary nature.

In the same year Borrel and his colleagues confirmed Bordet's observations, but decided that the presence of other peculiar elements in broth cultures precluded a purely vibrionic interpretation. From certain star-shaped bodies which they described, and the detection of mucin in the cultures and surrounding the constituent elements, they dubbed it the *Asterococcus mycoides*.

Frosch, in 1922, finding it impossible to get impression preparations of agar colonies and distrusting Bordet's observations of vibrionic forms, studied the agar growths by ultra-violet light photography. His published photographs were most unsatisfactory, but he saw enough to convince him that he had to deal with a fungoid organism, possibly allied to the saccharomyces. He suggested the name *Micromyces peripneumoniae bovis contagiosa*.

In 1925 Barnard took up the study of this organism by ultra-violet light and put forward a very unusual cycle of events. He took no cognizance of the vibrionic forms of Bordet and does not appear to have used staining methods.

Elford, in 1929, discussed only two forms, one a sphere of 0.2μ - 0.25μ and a particle. He determined by collodion filtrate experiments that the average size of the particle was 0.125μ - 0.15μ . He also says nothing about the polymorphism of this organism.

Bechhold and St. Sierakowski, in 1926, tried to make the pleuropneumonia elements visible by gilding them and examining them in the ultra-microscope. They make the strange remark that by ordinary light there was hardly anything definite to be recognized, not even after staining.

Since then Ørskow, 1927, had published observations of early colonies on agar and could find no evidence controverting Bordet's observations, while most recently Wroblewski (1931), in a short paper without illustrations, records his findings which point strongly to this organism being some kind of fungus.

The speaker had no difficulty in confirming the old observations of Bordet and Borrel with regard to the occurrence of vibrionic forms, using the Giemsa stain. It would seem, in fact, that the solid spherical and ring forms could readily be converted into thread forms by the method of preparing the film or by allowing 37° -grown cultures to stand in the cold. The organism appeared, therefore, to be of a highly plastic nature.

Agar cultures, however, gave the key to the cycle of events, and he had had no difficulty in securing impression preparations of the agar growths at different stages by pressing clean slides strongly down on the growths in order to overcome the difficulty, met with by observers long ago, that the pleuropneumonia colonies bury themselves rapidly below the surface.

The speaker demonstrated a number of impression preparations got in this way and stained by Giemsa, and said that, provisionally, at any rate, he preferred to consider the organism as one with fungal affinities, or possibly allied to the myxobacteria. What passed the filter was most probably a minute spore which

promptly germinated to the mycelial-like threads which were such a feature of early cultures. There were also to be seen in impression preparations what appeared to be fruiting bodies which doubtless gave rise to these minute filterable spores.

He proposed to get expert mycological opinion on the preparations and the various points at issue. ✕

DR. S. P. BEDSON.—Ever since the discovery that minute bodies resembling organisms could be demonstrated by suitable staining methods in material from fowlpox (Borrel, 1904) and vaccinia (Paschen, 1906), a considerable number of workers have confirmed these findings and extended them to other members of the group of so-called filterable viruses. And though there has been a period in the history of these minute bodies when they were lightly dismissed by the majority as some form of artefact, at the present time most virus workers are prepared to give them serious consideration. The problem which confronts us now is not so much concerned with the existence of these elementary bodies or how best to demonstrate them, but the relation which they bear to the virus. Are these bodies in fact virus bodies, or do they represent some product of tissue degeneration peculiar to virus infections? I have endeavoured to answer this question in the case of psittacosis virus, and since my findings in this investigation have formed the subject of a recent publication (Bedson, 1932), I will do no more than summarize them here. Elementary bodies have been described in psittacosis material (Coles, 1931; Levinthal, 1931; Lillie, 1931). They are oval or round in shape, somewhat larger than the Paschen bodies of vaccinia, and stain readily by any of the accepted methods. In addition they can be rapidly stained by the method devised by Castaneda for rickettsia. When a suspension of virulent mouse spleen, freed from the majority of tissue debris by short centrifugation or passage through a coarse filter, is centrifuged at 5000 r.p.m. for 2 hours, the major portion of the virus is thrown down in the deposit. This deposit can be purified by a process of fractional centrifugation and washing, the end product being a deposit consisting almost entirely of elementary bodies. And when this washed deposit is taken up in saline a faintly opalescent suspension is obtained which contains no protein, or only the faintest trace detectable with salicyl sulphonic acid, but which yet possesses a considerable proportion of the virulence of the original suspension of mouse spleen. The elementary bodies would seem to be definitely associated with the virus, and, since they are agglutinated by an antipsittacosis serum made in the guinea-pig with guinea-pig virus, but remain unaffected by an anti-mouse spleen serum also prepared in the guinea-pig, the conclusion that these bodies are the virus seems warranted.

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DR. REDCLIFFE N. SALAMAN and DR. C. C. HURST.—It is well known that intra-cellular inclusions or virus bodies are found in many virus diseases of plants and animals. Use has been made of the potato material resulting from the analysis and synthesis of virus diseases in terms of the specific virus entities X, Y, and Z, and Leaf Roll, to examine the histology and cytology of the leaf laminae with particular reference to such bodies.

Inclusion bodies are only found in potato plants which show some definite symptom of disease during the season. "Carriers," no matter what virus elements they contain so long as they appear perfectly healthy, are free of inclusions in the leaves. ✕

Plants infected with the X virus, either alone or in combination with other virus elements Y, Z, or Leaf Roll, and presenting symptoms, if not cut at too young a stage, invariably contain inclusion bodies. ✓

Plants infected with the Y virus alone, have never been found to contain inclusion bodies in the leaves, no matter how serious the clinical effects may be.

Plants infected with the Z virus alone, so far contain no inclusion bodies, but as only half a dozen plants have been examined, it is not possible to make a general statement at present.

Plants infected with Paracrinkle present a distinct cytological picture, but no inclusion bodies have been observed in their leaves.

Plants suffering from Leaf Roll present a very characteristic cytological picture, but they do not contain inclusion bodies unless there is a concurrent infection with the X virus.

Inclusion bodies in the Solanum family have been described in detail by various authors; those found in the potato are not distinctive. The protein crystalloid bodies described in tobacco mosaic are rarely seen in the potato.

Whilst we are not prepared to say that the X virus alone in the potato is responsible for the formation of inclusion bodies, we do find that the evidence for their existence apart from this virus entity is limited.

The results of this investigation support the views of Henderson Smith and other workers that the inclusion bodies are made up of aggregated granular particles which arise from the reaction of the virus with the cytoplasm and do not represent a gross organism, as has been occasionally suggested. ✕

PROF. JAMES MCINTOSH.—To-day I wish to give a short account of some views on the practical value of microscopy in the study and identification of filter-passing microbes, which have been built up as a result of some twenty years' experience.

I believe that the majority of filter-passing viruses do not differ in any essential way, apart from the question of size, from visible bacteria. The dividing line between them, as you are all well aware, is one of size depending on a purely artificial basis—that of the wave-length of ordinary light. This limits their maximum size to just under 0.2μ , although many are very much more minute. ✓ For this reason, therefore, I cannot see why the methods applied to the study of visible microbes by bacteriologists should not also be applied to that of filterable viruses, such as microscopical examinations, cultural studies, and animal inoculation; but their application, owing to the characteristic peculiarities of filterable viruses, is much more difficult. ✕ In the first place, there is the extreme minuteness of some of the viruses, and in the second, cultures have only been obtained with difficulty. / We have had to rely, therefore, mostly on the pathological action of these viruses for their identification. In fact, at the present time, we can say we know of no non-pathogenic filter-passing virus, because without animal inoculation the microscopic and cultural methods alone are unconvincing. ✕ But it is hoped that the advances which have been made in microscopy in the last few years, of which Mr. Barnard has just shown some new examples, will remedy this deficiency. Already high-power microscopy has shown us much concerning the morphology of the filter-passing viruses.

Speaking, therefore, purely as a practical bacteriologist, I would put the value

of microscopy to the study and identification of filter-passing viruses in the following order :—

- (1) The histological study of the pathological lesions, including the study of virus bodies.
- (2) The direct examination of the virus.

(1) As I have indicated, a study of the microscopical changes produced in the tissues by the virus has proved most useful in the identification of the virus as an aetiological entity. By this procedure it was possible in the case of neurotropic viruses to distinguish and separate from one another, the lesions of encephalitis lethargica, cerebral poliomyelitis, herpes febrilis, vaccinia encephalitis, etc.

Again, much is to be learned from direct histological examination as to the real nature of the inclusion bodies found in the lesions. These inclusion bodies, such as the corpuscles of Gaurnier (vaccinia), Bollinger (fowlpox), etc., show a definite particulate or granular nature. This, together with the fact that the infectivity of the material is proportional to the number of these bodies, indicates that they probably consist of accumulations or aggregations of the virus. The accompanying lantern slide shows numerous inclusion bodies (corpuscles of Gaurnier) in a rabbit's cornea inoculated with vaccinia, while the second and third slides show a higher magnification of the same body and disclose clearly their granular nature. These bodies, when crushed or extracted, yield in certain cases actual virus particles—in this case Paschen bodies. For further particulars as to the nature of these bodies I would refer you to the publications of Ludford, Woodruff and Goodpasture.

Of an actual virus I will only show a couple of slides which were made from a preparation of Dr. Lewthwaite's from a case of tropical typhus, in which the virus bodies (*Rickettsia*) are clearly shown as small round particles.

(2) The demonstration of viruses by microscopical means presents certain difficulties, as you are well aware, but they have been to some extent overcome in recent years by the use of ultra-violet light, particularly in the case of certain of the larger viruses, such as pleuropneumonia, ectromelia, etc. With these a considerable degree of resolution is possible. But with the smallest viruses, even with the best apparatus, they appear only as dots or fine particles indistinguishable from the various particles constantly present in albuminous fluids, a fact which must always be borne in mind when some new virus has been discovered by this procedure. Certainly more convincing results have been obtained by staining methods in the case of these viruses, as has been shown by Paschen, Borrel, Ledingham, etc.

In conclusion, might I say that I feel that, in spite of the numerous and important facts which have been obtained by direct microscopy of filter-passing viruses, their study, unless combined with histology and animal inoculations, is, at the present time, liable to lead to error.

CAPT. S. R. DOUGLAS, F.R.S.—Two methods are usually employed in staining the elementary bodies seen in certain virus diseases. In both of these dried films are employed which are stained either by Giemsa's stain for 24 hours, or even more, at 37° C., or by carbol fuchsin after the application of Loeffler's mordant.

Both these methods have the disadvantage that a very considerable mass of stain is deposited on the surface of the elementary body which tends to distort the true shape and causes all such elementary bodies to appear spherical; in fact it has very much the same effect as the diffraction image, which, as the President has pointed out, is greatly enhanced when an objective of low numerical aperture is employed.

Two methods of staining have been employed of late at the National Institute for Medical Research which to a large extent obviate these disadvantages. The one for which my colleague, Dr. Laidlaw, is largely responsible, and which is extremely useful in demonstrating the elements in cytoplasmic inclusion bodies such as occur in ectromelia, is carried out as follows: The skin of a suitably infected foot is removed, and frozen sections are cut at right angles to the skin surface. Single sections are then placed for a short period (1 or 2 minutes) in a 30 p.c. solution of glycerine. This causes the inclusion bodies to swell up, so that when the section is wiped over the surface of the cover slip, many swollen, or partially disintegrated inclusion bodies adhere to the cover-slip. Without allowing the film to dry, the cover-slip is dropped, film-side downwards, into absolute alcohol. After preliminary fixation the cover-slips are reversed and allowed to remain in absolute alcohol until thoroughly hardened. They are then removed, washed in distilled water and stained in *acid fuchsin* 1-5 p.c. solution for about 5 minutes. After washing in distilled water, the stain is fixed by two applications of a 1 p.c. solution of phosphomolybdic acid for about $\frac{1}{2}$ minute each without intermediate washing.

The preparation is again washed in distilled water and the film is differentiated in 70 p.c. alcohol to which sufficient Orange G has been added to give the colour of pale sherry. When sufficient differentiation has been accomplished the specimen is dehydrated in absolute alcohol, cleared in xylol, and mounted in balsam.

(Microphotographs made by Mr. Barnard from a specimen prepared by this method were shown, and were compared with photographs of unstained partially disintegrated inclusion bodies rendered visible by dark-ground illumination. The elementary bodies in the stained preparation were seen to be rather smaller than those in the photographs rendered visible by dark-ground illumination.) ×

The second method consists of suspending the elementary bodies—or, in the case of pleuropneumonia organisms, a small quantity of culture—in a weak solution of Czaplewski's stain under a cover-slip sealed with vaseline. Czaplewski's stain is ordinary carbol fuchsin to which 50 p.c. glycerine has been added, and is used diluted about 1 in 20 with distilled water. Preparations from bovine pleuropneumonia cultures made by this method show numerous ring forms and very minute bodies, but spirochætal forms and other bizarre shapes are conspicuous by their absence. ×

Dr. W. J. ELFORD.—The remarks I wish to make by way of contribution to this discussion on the Microscopy of Filterable Viruses concern an aspect of microscopical technique which in this particular problem assumes more than ordinary importance, namely, the preliminary investigation and preparation of the object prior to direct examination by the methods of dark-ground microscopy and ultra-violet light photography. These pathogenic agents, the filterable viruses, so named and classified by reason of their ability to pass bacteriological filters which have been tested and proved to retain ordinary bacteria (*B. prodigiosus* as test organism), have not as yet been found amenable to cultivation in media indisputably free of living cells,* and hence it is necessary to use as starting material extracts from infected tissues. The customary procedure is to make an emulsion by grinding the tissue with sand in broth, or some other suitable medium. This emulsion is very heterogeneous, containing, in addition to the infective agent which is the object of inquiry, coarse tissue debris, cells, and tissue proteins, in varying degrees of dispersion. To search for the virus by microscopical examina-

* Eagles and McClean (1931) claimed to have cultivated vaccinia virus in cell-free filtrates, but this could not be confirmed by Maitland, Laing and Lyth (1932).

tion of this mixture would indeed be a hopeless quest. Accordingly it has been necessary to evolve a technique whereby this heterogeneous system may be resolved to a sufficiently uniform fraction suitable for microscopical study. This is accomplished by a process of graded filtration, using Gradocol membranes (Elford, 1931). The actual procedure has been described in detail already by Barnard and Elford (1931), but this is an occasion when I should at least briefly outline it, since it forms so essential a part of the general technique in the microscopy of viruses.

Preparation of Stock Filtrate.—The broth emulsion of infected tissue is filtered through a sand and pulp filter to remove all gross particles of tissue. Preliminary centrifugation of the crude emulsion for 10 minutes at 2500 rev./min. is frequently found helpful. The sand and pulp filtrate, which usually exhibits a definite opalescence, is then filtered through a membrane of grade 0.7–0.75 μ to yield a bacteriologically sterile filtrate possessing high virus infectivity. This serves as the stock virus suspension and the titre of its infectivity is determined by making animal inoculations with a standard dose of successive tenfold dilutions.

Investigation of the Stock Filtrate.—Having prepared in this way a stock infective filtrate, the next step is the determination of the filtration end-point of the virus, i.e., the limiting grade of membrane below which the filtrates are uniformly non-infective. This enables the probable size of the virus to be estimated, whence it is possible to decide whether or not the virus comes within the resolution limits of the optical system available for the subsequent examination.

Fractional filtration with suitably chosen membranes affords a means of resolving the initially polydisperse system into a relatively uniform suspension containing particles of the order of size of the virus. Such a preparation serves for the preliminary study by microscopical methods, but it is essential to have an extract of normal tissue, subjected to precisely the same treatment, as a control.

The potencies of virus extracts vary considerably, depending on several factors, such as the stage of the disease after incidence, the particular tissue used, and the degree of grinding to which it has been subjected, and also the nature and reaction of the extracting medium. These factors must be standardized as far as possible. It may be found necessary to concentrate the virus in order that its detection through the microscope may be facilitated. Unless the actual amount of virus present exceeds a certain minimum value, observation is very difficult in view of the extremely small volume examined in any given field, the liquid layer being only a fraction of a micron thick. Concentration may be effected by filtering off a proportion of the medium through a membrane which completely retains all the virus. The residual volume may be reduced, within practical limits, to any desired fraction of the original, and the concentration of the virus becomes augmented correspondingly.

This latter operation may be used further as a means of washing away dissolved proteins, the presence of which from the view-point of ultra-violet light photography is wholly undesirable, since they have an adverse influence on the quality of the image produced, by reason of specific molecular absorption and scattering of light. The more "optically transparent" the medium and the greater the disparity in refraction between it and the object, the better. The virus contained in the concentrated residuum referred to above is alternately diluted with distilled water or weak salt solution and reconcentrated, this process being repeated until the filtrate no longer gives a positive Millon or other suitable test for protein. The virus suspension purified in this way yields a much sharper photographic image, and the time of exposure is materially reduced.

These methods were worked out in the study of the virus of infectious ectromelia to which reference has already been made: This virus was estimated to be

0.1-0.15 μ in diameter from filtration data. Mr. Barnard gave its size as 0.13-0.14 μ from measurements of real photographic images of the minute spherical bodies believed to be the virus. This excellent agreement between the filtration and microscopical results shows the two methods to be mutually confirmatory. The fact that the presence of the virus can be demonstrated by animal inoculation only in those filtrates in which these bodies are observed, provides the only available evidence, in the absence of in-vitro cultivation, that the bodies are indeed the virus. Again, once it is admitted that the observed bodies constitute the pathogenic elements in these extracts, then the direct measurement of their size by optical methods checks the value predicted from filtration analysis.

General Considerations.—The complete analysis of a pathogenically active extract from infective tissue by the combined methods of graded filtration and microscopy or ultra-violet light photography, affords a general method of attack on the problem of the nature of the "filterable viruses."* As I stated in the discussion on the nature of the filterable viruses at the British Association Meeting of last year, "filtration evidence indicates that the viruses cannot as a class be differentiated sharply from ordinary bacteria by any marked gulf existing between their relative sizes. On the contrary, the viruses have sizes ranging from those of the smallest recognized bacteria down to within two or three times the size of serum proteins and oxyhæmoglobin." The following table gives the sizes of some of the viruses for which the filtration analysis has been completed:—

	<i>Estimated size of Filtration.</i>	
Vaccinia virus—testicular strain	0.125-0.175 μ	Elford and Andrewes (1932).
Infective ectromelia	0.1-0.15 μ	Barnard and Elford (1931).
Herpes virus	0.1-0.15 μ	Elford, Perdrau, and Smith (not yet published).
Foot and mouth disease virus	8-12 $\mu\mu$	Galloway and Elford (1931).

In view of the success achieved in the case of infectious ectromelia, the above figures would indicate that photographs of other viruses, such as vaccinia virus and herpes virus, may be confidently anticipated, but the virus of foot and mouth disease, and, incidentally, the bacteriophages, would appear to await the further development of the optical methods available. x

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PROF. E. HINDLE.—The "cell inclusions" or "virus bodies," which are characteristic of so many virus diseases, could not all be interpreted as aggregations of minute organisms embedded in the products of a cellular reaction towards the infection. The majority of the previous speakers had stressed this interpretation, as they dealt with virus bodies in which the particulate nature was evident; but in the case of other virus bodies, there was no evidence of their being anything but the result of specific metabolic changes in the cell. Thus the intranuclear bodies of virus diseases of insects had been shown to be non-infective, and the Negri bodies found in rabies also seemed to be the result of specific changes in the cell. In the case of yellow fever, the characteristic intranuclear inclusions of the

liver cells showed a particulate structure, but there was no evidence that these small granules represented actual organisms, with or without products of nuclear metabolism. On the contrary, these intranuclear bodies, although present in almost every monkey infected with yellow fever, had only been found in a small percentage of human cases, although in both instances the liver contained virus. It seemed more reasonable, therefore, to interpret these particular virus bodies as the products of metabolic changes in the nucleus or nucleolus.

With regard to the applications of microscopy in the study of filterable viruses in general, he expressed the opinion that the study of the characteristic cytological changes produced by the various disease agents was likely to be of more practical value to the majority of laboratory workers than the very refined methods of ultra-microscopy. An expert, such as Mr. Barnard, using elaborate apparatus, had obtained very important results as to the size of virus particles, and the direct measurements thus obtained offered a striking confirmation of the sizes estimated by the use of special methods of filtration or centrifugation. Without wishing to detract from the interest of these observations, it should be emphasized, however, that the interpretation of the nature of any minute particles thus demonstrated depended upon actual experiment, and even in the case of very much larger organisms, such as the majority of bacteria, their identification was generally impossible without the aid of biological tests. Consequently, he was of the opinion that the discovery of culture methods, leading to the identification of virus bodies by methods similar to those used in bacteriology, offered a more hopeful line of advance than the application of the refinements of ultra-microscopy.

MR. B. K. JOHNSON.—In contributing to the discussion on the above subject I wish to confine my remarks to the microscopy aspect rather than the biological side of this question.

Whilst it will be at once admitted that the microscope may be only one of several means available for attacking this whole problem, it must necessarily be a tool of considerable importance if it enables a filterable virus to be rendered visible. The dimensions of such organisms (if organisms they be) or bodies preclude them from being recognized by the aid of the highest power microscope used with visible light, owing to the fact that they are below the resolving power capabilities of the highest numerical aperture objective that can be employed with such an instrument. If, however, the ultra-violet microscope be employed (in which the object is illuminated by radiation of half the wave-length of the visible spectrum, thus doubling the resolving power of the instrument) the possibility of detecting the presence of these bodies in recognizable form will be greatly increased, and may, in fact, actually be achieved.

In this connection I would urge the more general use of ultra-violet microscopy for this and other research work, for it still has not received the attention it most surely deserves. It is not even yet realized (in spite of considerable literature published on this subject in recent years—see references below) that results obtained with this instrument are far superior to those which can ever be obtained by the microscope with visual light. It has now been shown, both quantitatively and qualitatively, that double the resolving power can be attained, and, moreover, a no less important point which has made itself evident is the selective absorption and reflection effects produced by the specimen under the influence of different ultra-violet wave-lengths. These effects produce such marked contrasts that it is not necessary to resort to staining methods, and thus the specimen may be examined in its natural living state. This latter point is in itself of sufficient importance to justify (for some types of object) the use of even low-power quartz

objectives (e.g., the 6 mm.) with ultra-violet illumination, without necessarily employing higher resolution.

Besides the fact that the results yielded by ultra-violet microscopy have not been realized, there are two other reasons which have prevented this method from being used hitherto: one is that the apparatus is thought of as being extremely complex and difficult to use; and the other is that the equipment is looked upon as an extraordinarily expensive piece of apparatus. For some time past I have attempted to dispel these ideas. In the first place, there is no reason why the microscopist who is familiar with high-power photomicrographic methods should not, after having thoroughly grasped the technique of U.V. methods, obtain perfectly satisfactory results. Secondly, whilst the quartz optical system is still of an expensive character, there are means now available whereby two parts of the apparatus (namely, a method of fine adjustment, and an electrical equipment for producing the spark source) have been put within the reach of almost all microscopists. These have been described elsewhere (see references below), and I am exhibiting the special form of fine adjustment at this meeting.

I fear I may have digressed from the main point of this discussion; nevertheless it is very necessary to emphasize the importance of these new methods in microscopy when so little attention has been paid to them. Valuable results can and will be further obtained if only these methods are taken advantage of by a greater number of workers.

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DR. G. M. FINDLAY.—If advances are to be made in the microscopy of the filterable viruses it is obvious that technical methods must be elaborated for the separation of these viruses from the colloidal particles with which they are so intimately associated in the cells of animals and plants.

Results obtained by the use of differential centrifugation and differential filtration have already been discussed. Two other techniques which as yet have been but little applied to the study of ultra-microscopic viruses are, however, also worthy of brief mention. These methods are: (1) Adsorption and elution; (2) Microdissection.

The method of adsorption and elution was first applied to the purification of enzymes by Willstater, and consists first in the adsorption of the material to be purified on kaolin, alumina, animal charcoal, or some similar substance, followed by its separation or elution from the absorbent by a fluid. In certain unpublished experiments carried out by my colleague, Dr. J. C. Broom, and myself, it has been found possible to adsorb and elute the virus of vaccinia. As in the purification

of many enzymes, it was found that various specimens of kaolin vary in the readiness with which they adsorb vaccinia from a suspension of the virus. A greater degree of adsorption is also obtained if to the original suspension of the virus there is first added a dilute solution of lead acetate, which precipitates much of the protein material present. For the elution of the virus from the kaolin, the two substances which have given the best results are beef broth buffered at pH 7.2, and a dilute solution of ammonium phosphate. When vaccinia virus eluted by ammonium phosphate is subjected to high-speed centrifugation, the virus, as shown by animal experiments, is very largely thrown down, and if the residue thus obtained is stained by Giemsa's method, there are seen to be present fine granules just within the limits of resolution of the microscope.

The method of microdissection, as initiated by Prof. Chambers, has as yet been little used in the study of filterable viruses, except by Goodpasture in his examination of the Bollinger bodies of fowlpox. It is possible that the use of this method might throw further light on the nature of the intranuclear bodies which are characteristic of a number of virus diseases. At present it is not known whether these bodies actually contain the virus or not. They can, however, be seen to arise in the nucleoplasm, are acidophilic in character, and are visible in the fresh, unstained cell.

All the evidence at present available goes to suggest that the filterable viruses form a large and heterogeneous class, some of which are but little smaller than ordinary bacteria, while others are but little bigger than protein molecules. The possibility that the virus of pleuropneumonia resembles a bacterium in certain respects has already been suggested. Bydgosz has recently brought forward evidence to show that the agent of agalaxia of sheep and goats also has a complicated life history involving granular, mycelial and conidial forms.

If these results are confirmed they suggest that no clear line of demarcation can be drawn between visible bacteria and ultra-microscopic viruses.

On the motion of the President, cordial votes of thanks were accorded to the foregoing gentlemen for their valued contributions to the discussion, and for their exhibits in connection therewith. Votes of thanks were also accorded to Messrs. R. & J. Beck, Ltd., and to Messrs. W. Watson & Sons, Ltd., for the loan of microscopes.

Announcement.—The President announced that the Biological Section would meet in the Pillar Room on Wednesday, May 4th, 1932.

The proceedings then terminated.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD IN THE HASTINGS HALL, BRITISH MEDICAL ASSOCIATION HOUSE, TAVISTOCK SQUARE, LONDON, W.C.1, ON WEDNESDAY, MAY 18TH, 1932, AT 5.30 P.M., MR. CONRAD BECK, C.B.E., PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the President.

New Fellows.—The following candidates were balloted for and duly elected Ordinary Fellows of the Society :—

John Lewis Bremer, M.D., Boston.
 Otto Langer, Dorking.
 Frederic Thomas Lewis, A.M., M.D., Boston.
 Paul K. Losch, D.D.S., Boston.
 Harold Lorraine Weatherford, M.A., Ph.D., Boston.

Nomination Certificate in favour of the following candidate was read for the first time, and directed to be suspended in the Rooms of the Society in the usual manner :—

Leslie Stephenson Hiscott, Richmond.

The Death was reported of :—

George F. Bates. Elected 1920.

A vote of condolence with the relatives was passed.

Donations were reported from :—

Cambridge University Press—

“The Invertebrata. A Manual for the Use of Students.” By L. A. Borradaile, L. E. S. Eastham, F. A. Potts, and J. T. Saunders.

Prof. Sterling B. Talmage, Ph.D., F.R.M.S.—

“Microscopic Determination of the Ore Minerals.” By M. N. Short.

Messrs. Baillière, Tindall & Cox—

“Principles of Soil Microbiology.” By S. A. Waksman.

Herren S. Hirzel—

“Leitfaden der mikroskopisch-anatomischen Untersuchung pathologischer Objekte, des Blutes und des Zentralnervensystems.” By G. C. van Walsem.

M. Paul Lechevalier—

“Faune de France, Vol. 23. Diptères Chironomidæ IV.” By M. Goetghebuer.

Dr. G. de Toni—

“Bibliographia Algologica Universalis.” By J. de Toni. Fasc. II: Ba-Bonnem.

Mr. David Bryce, F.R.S.E., F.R.M.S.—

“Opinions rendered by the International Commission on Zoological Nomenclature,” Nos. 1–123 (1910–31).

Votes of thanks were accorded to the donors.

Balance Sheet.—The President then called upon the Treasurer, Mr. C. F. Hill, to present his Financial Report and Balance Sheet for the year 1931.

FINANCIAL REPORT FOR THE YEAR ENDED DECEMBER 31st, 1931.

The Accounts show a balance of Expenditure over Income of £39 16s. 3d., which, added to the balance of £249 18s. 9d. brought forward from the previous year, makes an accumulated debit on this account of £289 15s.

No new Life Members have been elected during the year, and the Life Membership Account therefore remains at £1979. The investments standing in the books at £2176 1s. 5d. had a market value on December 31st, 1931, of £2012 9s. 7d. It is not proposed to make any provision for depreciation of investments, as there is little doubt they will eventually recover. It is interesting to note that this is the first time the market valuation of the investments has been below the book value since they were written down during the war period.

The Loan Account due to the Treasurer has been further reduced by a donation of £50, leaving £200 outstanding.

It was noted in my last Report that until the expiration or sooner determination of the Society's unexpired Lease of Premises at Hanover Square, a heavy liability was involved on account of rent and accrued dilapidations therein, and it is a pleasure to report now that as a result of the successful negotiations conducted by the Secretary with the Society's late landlords, this liability has been finally discharged without cost to the Society, and the Rent Account should show a substantial reduction next year.

During the year the Society has undertaken to contribute toward the cost of the handsome showcase which now houses a portion of the collection of historical instruments, and as it is thought advisable to make an allowance for depreciation of furniture and equipment, the sum of £27 8s. 7d. has been provided out of income for this account.

Regarding the Journal, the net cost of this is only £1 more than last year, notwithstanding the fact that the sales have decreased somewhat, doubtless due to the present difficult times.

On the Income side of the Accounts, receipts from Fellows' Subscriptions have fallen by £7, and donations and sundry receipts are down by £66. On the other hand, Admission Fees and interest on investments and income from advertisements show an increase.

I again have pleasure in expressing my personal thanks and appreciation to the Secretaries, and to the Honorary Auditors, Messrs. Thomson McLintock & Co., for their valuable services to the Society during the year.

Mr.

INCOME AND EXPENDITURE ACCOUNT

£	1980.	$s.$	$d.$		£	$s.$	$d.$		£	$s.$	$d.$
275	8	0	To Rent, Lighting, Heating and Insurance						216	9	11
450	8	0	" Salaries, Reporting, etc.						350	10	0
			" Sundry Expenses— Library Books and Binding		30	12	11				
			Stationery, Printing, Postages and Sundry Expenses		122	9	7				
			Repairs and Renewals			2	14	0			
			Refreshments at Meetings			8	6	0			
212	15	5							164	2	6
			" Journal— Expenditure— Printing		786	16	5				
			Editng and Abstracting		207	16	6				
			Illustrating		129	14	1				
			Postage and Addressing		65	2	2				
			Less Receipts— Grant from Royal Society 200 0 0		1189	9	2				
			Sales		496	13	3				
			Advertisements		116	2	0				
375	1	2							812	15	3
			" Depreciation on Furniture						376	13	11
									27	8	7
<u>£1313</u>	<u>12</u>	<u>7</u>							<u>£1135</u>	<u>4</u>	<u>11</u>

Dr.

BALANCE SHEET AS AT

LIABILITIES		£	s.	d.	£	s.	d.
I. Capital—							
Being (a) Life Compounded Subscriptions received from 1st January, 1877, to 31st December, 1931		1979	0	0			
(b)	Quekett Memorial Fund.	100	0	0			
(c)	Mortimer Bequest.	45	0	0			
(d)	A. N. Disney Bequest	100	0	0			
(e)	Amounts received in respect of Sales of Books from the Library (surplus to the Society's requirements)	253	12	0			
					2477	12	0
II. Loan.					200	0	0
<p><i>Note.</i>—The Hon. Treasurer of the Society has advanced this sum to meet the cost of publishing "The Microscope and Catalogue of Instruments." The loan is made to the Society free of interest.</p>							
III. <i>Summary Creditors</i> —							
	Subscriptions paid in advance	67	14	0			
	Journal Subscriptions paid in advance	104	7	3			
	On account of Journal Printing, etc.	395	14	3			
					567	15	6

£3245 7 6

London, 5th April, 1932. We have examined the Books and Accounts of the Royal Microscopical Society for the year to 31st December, 1931, and have found the transactions correctly recorded and sufficiently vouched.

In our opinion the foregoing Balance Sheet is properly drawn up so as to exhibit

CYRIL F. HILL, *Hon. Treasurer.*

FOR YEAR TO 31ST DECEMBER, 1931.

Cr.

1930.	£	s.	d.	INCOME.	£	s.	d.	£	s.	d.
				By Subscriptions	823	1	11			
				„ Subscriptions for 1931 unpaid	35	2	7			
865	18	7						858	4	6
118	8	5		„ Donations and Sundry Receipts				52	6	6
58	16	0		„ Admission Fees				67	4	0
108	12	5		„ Interest on Investments and Deposit Account				117	13	8
161	17	2		„ Balance, being excess of Expenditure over Income for year to date				39	16	3

£1313 12 7

£1135 4 11

31ST DECEMBER, 1931.

Cr.

ASSETS.				£	s.	d.	£	s.	d.
I. Furniture and Equipment—									
As at 31st December, 1930				223	1	10			
Additions during year				51	4	3			
					274	6	1		
Less: Sales during year					4	7	6		
Depreciation at 10%					27	8	7		
					31	16	1		
							242	10	0
							2176	1	5
II. Investments at Cost									
£400 London & North Eastern Railway Co. 3% Debenture Stock.									
£500 Nottingham Corporation 3% Irredeemable Debenture Stock.									
£915 11s. 4d. India 3% Stock.									
£150 Metropolitan Water Board "B" Stock.									
£612 London Midland & Scottish Railway Co. 4% Preference Stock.									
£200 New South Wales 5½% Loan, 1947-57.									
£421 1s. 0d. 5% War Loan, 1929-47.									
£200 5% Conversion Loan, 1944-64.									
Note.—The Market Valuation of the above investments at 31st December, 1931, was £2012 9s. 7d.									
III. "The Microscope and Catalogue of Instruments"—									
Amounts expended on publication to date, less sales in previous years				248	10	11			
Less Sales for 1931				48	10	10			
Note.—The Hon. Treasurer of the Society has given his personal guarantee to meet any part of this expenditure that is not recovered by means of sales of the publication.							200	0	1
IV. Sundry Debtors—									
Subscriptions unpaid, amounts due in respect of Journal, Sales, Advertisements, etc.							121	0	6
V. Cash at Bank and in Hand—									
At Bank on Deposit Account				100	0	0			
On Current Account				115	2	8			
In Hand					17	10			
VI. Income and Expenditure Account—							216	0	6
Balance as at 31st December, 1930				249	18	9			
Add: Excess of Expenditure over Income for year to date					39	16	3		
							289	15	0
							£3245	7	6

a true and correct view of the state of the Society's affairs, subject to it being noted that no account has been taken of the value of the Society's Library, Stock of Journals and Collection of Instruments (valued for insurance, together with the Furniture and Equipment at £7000).

(Signed) THOMSON McLINTOCK & CO.,
Chartered Accountants, Hon. Auditors.

71, Queen Street, E.C. 4.

The number of Fellows on the Roll of the Society at December 31st, 1931, is as follows :—

Number of Fellows on the Roll at December 31st, 1930		493
Fellows elected prior to December 31st, 1930, but completed since December 31st, 1930		3
		<hr/> 496
Fellows elected during year—		
Honorary	3	
Ordinary	29	32
	<hr/>	
Fellows reinstated during year	5	37
	<hr/>	<hr/> 533
Fellows resigned (14) or removed (6) during year	20	
Fellows deceased during year	13	33
	<hr/>	<hr/> 500
		<hr/>

The total is made of :—

(a) Ordinary Fellows	459
of whom *421 have paid current sub-	
scription	
20 are one year in arrear	
18 are two years in arrear	
	<hr/> 459
	<hr/>

(b) Life Fellows (3 Fellows died during year) .. 27

(c) Honorary Fellows—

Number on Roll at December 31st, 1930	12
Elected during year	3
	<hr/> 15
Deceased during year	1
	<hr/> 14
	<hr/> 500

On the motion of Mr. C. F. Hill, seconded by Mr. H. Taverner, the Report and Accounts were unanimously approved and adopted.

Mr. A. W. Sheppard, seconded by Mr. J. Wilson, then moved the following resolution, which was carried with acclamation :—

Resolved :—

“ That the best thanks and appreciation of the Fellows be conveyed to Messrs. Thomson McLintock & Co., for their valued services to the Society as Honorary Auditors during the past year.”

* In addition, 13 Fellows paid their current year's subscription previous to death or resignation.

Exhibits.—An exhibition of hand magnifiers and pocket microscopes was held, to which the following firms contributed :—Messrs. C. Baker, R. & J. Beck, Ltd., E. Leitz (London), W. Ottway & Co., Ltd., Third Hand Patent Magnifier Warehouse, W. Watson & Sons, Ltd., and Carl Zeiss (London), Ltd.

Papers.—The following communications were read :—

Prof. Hamilton Hartridge, F.R.S.—

- (1) "A Microscope Projector for Making Drawings."
- (2) "A Microscope Projector for Lecture Purposes."

A discussion followed in which the following gentlemen took part :—The President, Mr. J. E. Barnard, Mr. C. H. Oakden, Mr. J. Rheinberg, and Mr. C. D. Soar.

The following paper was communicated by Mr. J. E. Barnard, who subsequently exhibited a cinematograph film in connection therewith :—

Dr. P. R. Peacock, M.B., B.S., and Dr. L. Woodhouse Price, B.A., M.R.C.S., L.R.C.P.—

"On the Cinematographic Examination of Serial Sections as an Aid to Histology."

Hearty votes of thanks were accorded to the authors of the foregoing communications, to Mr. Barnard, and also to the exhibitors.

The following papers were read in title :—

Miss Dorothy I. Clements—

"Comparative Histological Studies of the Thyroids and Pituitaries in Frog Tadpoles in Normal and Accelerated Metamorphosis."

Mr. E. Heron-Allen, F.R.S., F.R.M.S., and Mr. Arthur Earland, F.R.M.S.—

"Foraminifera from the South Atlantic, IV. Four New Genera from South Georgia."

Dr. G. P. Matthews, D.M.D., F.R.M.S.—

"Method for Vertical Micro-projection with Carbon Arc as Illuminant."

Mr. L. Rama Rao, M.A.—

"Some Radiolaria from the Trichinopoly Cretaceous—S. India."

Miss Betty M. L. Underhill, B.A., B.Sc.(Oxon.)—

"The Rate of Penetration of Fixatives."

Announcements.—The President made the following announcements :—

The next Ordinary Meeting of the Society will be held on Wednesday, October 19th, 1932.

The next Meeting of the Biological Section will be held on Wednesday, November 2nd, 1932.

SUMMER VACATION.—The Rooms of the Society will be closed for the Summer Vacation from August 15th to September 10th, 1932.

The proceedings then terminated.

JOURNAL
OF THE
ROYAL MICROSCOPICAL SOCIETY.

SEPTEMBER, 1932.

TRANSACTIONS OF THE SOCIETY.

X.—SOME NEW FORAMINIFERA FROM THE SOUTH ATLANTIC. 593. 12.

IV.

FOUR NEW GENERA FROM SOUTH GEORGIA.

By E. HERON-ALLEN, F.R.S., and ARTHUR EARLAND, F.R.M.S.

(Read May 18th, 1932.)

TWO PLATES.

THE Island of South Georgia lies between 54° and 55° South Latitude, approximating to the Isle of Man in the Northern Hemisphere, and is only some 2-3 degrees farther south than the Falkland Islands, which approximate, in this southern position, to our North Devon and South Wales coasts. But while the Falklands in the Southern Hemisphere, under the influence of the warm Pacific water coming through the Drake Straits, present a temperate fauna not unlike that living on our own shores, which benefit by warm Atlantic currents, South Georgia lies outside the influence of the Pacific warm water, and, being surrounded by the northward flow of the cold Antarctic current, lies within the region of pack ice. The island rises more or less abruptly from deep water, so that the 100-fathom line lies quite near the coast. The land area is mountainous and ice covered, and there are many glaciers, some of which run down into the sea. These conditions influence the coastal deposits, which are generally composed of a tenacious blue mud, of which diatoms, so abundant in Antarctic waters, form a notable constituent. The foraminiferal fauna is very distinctive, and in view of the fact that no previous work has been done in the area, it is not surprising

that the material gathered by the R.R. ships *Discovery* and *William Scoresby* has yielded several genera and many species new to science.

Order : FORAMINIFERA.

Family : MILIOLIDÆ.

Sub-Family : Peneroplinidæ.

Gordiospira. Gen. n.

Test free, porcellaneous, very thin-walled and fragile, approximately circular in shape, consisting of a proloculum around which a non-septate tubular chamber forms several coils in different planes, finally becoming planospiral and involute for several convolutions. In the planospiral stage the tube rapidly expands in width and thickness. The umbilical area is depressed and reveals the edges of some of the earlier convolutions. Aperture large and terminal.

Gordiospira is isomorphous with *Glomospira* Rzehak (1885), but the irregular convolutions of the initial coil are less visible externally. They become very evident in transparent preparations.

Gordiospira fragilis. Sp. n.

(Pl. I, figs. 1-6.)

Stations 45, 144, 145, 149, WS33, MS68.

Test free, porcellaneous, oval when young, becoming circular with full growth, very thin and fragile, papery white or translucent, surface often irregular, and marked with recurved lines of growth. Viewed as an opaque object, it exhibits 2-3 planospiral and embracing whorls of a tube which increases in diameter and thickness so rapidly that the final convolution forms the bulk of the entire test. The central portion of the test is depressed, and shows one or two transverse tubes. The aperture is terminal, very large, the outer margin projecting, the inner margins recurved to join the previous whorl.

Viewed as a transparent object *Gordiospira fragilis* is seen to consist of a proloculum, around which an unseptate tube is irregularly coiled in 3-5 convolutions set in different planes. Subsequently the tube becomes planospiral, forming 2-3 convolutions rapidly increasing in size and thickness. These later convolutions are involute to some extent, each concealing at least half of the previous convolution.

The surface of the tubes is often rather irregular and always exhibits faint recurved lines of growth.

Both megalospheric and microspheric forms have been identified, the latter being the larger, as usual. The megalospheric proloculum is about 0.02 mm. in diameter, the microspheric too small to be measured with

certainty. The size of the test ranges up to 1.5 mm., or rather more, in diameter, but the general average is under 1.0 mm.

Small specimens are usually oval in contour owing to the change in shape when the tube assumes the planospiral condition. After the first planospiral convolution it rapidly assumes a more circular contour.

Specimens taken direct from spirit, stained and mounted in balsam, show that the protoplasmic body is voluminous, almost filling the tube from end to end. The protoplasm is finely granular and filled with food bodies, including diatoms and spicules.

Gordiospira fragilis was observed at six Stations in South Georgia and is frequent at Stations 45, 149, MS68, at each of which a series in all stages was obtained. In depth its range extends between 26–270 metres.

Family : ASTORRHIZIDÆ.

Sub-Family : Saccammininæ.

Pelosphæra. Gen. n.

Test large, free, roughly spherical, constructed of large and small irregularly shaped mineral grains cemented firmly together with copious cement which, externally, is soft and friable but internally firm and smooth. Furnished externally with two or more projecting processes, conical in shape, hollow, formed of fine sand grains and loosely aggregated mud and cement, similar in appearance to the external cement between the sand grains of the test. There is no visible external aperture to either the test or the processes, but the processes extend from, and conceal, large apertures in the test, which are clearly seen from the inside when the sphere is laid open.

This is a very distinctive form in the perfect condition, but the conical processes are so friable that few specimens retain them throughout the cleaning process. Devoid of processes, the specimens, except for their abnormal size, would pass for *Psammosphæra fusca*, the apertures being usually concealed by mud. Only a few young individuals were found. These bear two processes only, sometimes almost equalling in length the diameter of the sphere, and are usually, but not always, built of smaller sand grains than those employed by the adult organism.

Pelosphæra is no doubt closely allied to *Psammosphæra*, but, even without its typical processes, would be distinguishable by its relatively enormous size and the friable nature of the external cement.

Pelosphæra cornuta. Sp. n.

(Pl. II, figs. 12–15.)

Stations 17, 27, 126, 144, 148.

The characteristic features of the genotype have been given under the description of the genus. The best specimens, both large and small, were

obtained at Stations 126, 144, 148, where the material was obtained from nets attached to the trawl, and the specimens had been subjected to less friction than at Station 27. At this Station dredged material had been passed through sieves, with the result that few specimens retained the characteristic processes. It is of frequent occurrence at Stations 27, 126, 148—rare elsewhere. At Station 17 the only specimen found was abnormal, both in size and shape. It is roughly triangular in outline, about 6.0 mm. in greatest diameter, and constructed of relatively enormous sand grains. A specimen from Station 148 which was laid open contained a large, orange-coloured sphere almost filling the central cavity, which is probably the protoplasmic body in a chitinous envelope. Similar enclosures have been found in *Pelosina*.

Dimensions range between 3.0–5.0 mm. in diameter.

Armorella. Gen. n.*

Test free, monothalamous, approximately spherical, furnished with a variable number of extended tubes of different lengths, with an aperture at the end of each tube. Wall firm, but very thin, constructed of fine sand, diatoms and sponge spicules incorporated with much cement, occasional larger sand grains and spicules projecting from the otherwise smooth and rather shining surface. Interior surface similarly smooth. Colour light grey.

This is a very distinctive form, closely allied to *Thurammia* and *Tholosina*, its affinities probably lying with the latter genus. Small specimens furnished with short tubes or remains of broken tubes are very like *Thurammia papillata* in their spherical form, but a series of specimens links them up with the large and multi-tubular individuals which have no resemblance to that species. Moreover, the broken tube-ends are very unlike the apertures of *Thurammia*.

Small sponge spicules are often employed to a considerable extent as building material, being smoothly incorporated in the wall. At Station 144 they play a larger part than usual in construction, the sphere in some cases being built round a bundle of spicules, the ends of which may project to an extent equal to the diameter of the test. This spicular construction to some extent also modifies the shape of the test, which tends to become polyhedral instead of spherical. Such tests are probably not evidence of selective powers, or only to a limited extent as compared with the use of spicules in *Psammosphaera rustica*. But these projecting spicules would undoubtedly serve a useful purpose in supporting the organism in the surface layer of mud, and this would be of value to the animal, which is not one of the mud-eaters. The protoplasmic body is large, but not loaded with mud and diatoms, as in many *Arenacea*.

* In Memory of Armored Daphne Heron-Allen, who died July 3rd, 1930, aged 22.

On the other hand a specimen found at Station 45 exhibits a definite instance of selection similar to *Psammospheera parva*, the spherical test, which is very neatly built of fine sand only, being transfixd by a very long spicule (fig. 9).

These projecting spicules are sometimes used as supports for the tubes which are attached to them. But there is no general practice, and frequently a tube is seen growing out quite close to a projecting spicule, but unattached.

Armorella has probably a wide distribution in deep or cold waters. A similar organism, though specifically distinct, has been found in several dredgings round the British Isles, but always of rare occurrence. Several of the figures in Haeusler's papers attributed to *Thurammina* would appear to be referable to our genus, in which case its record extends back to Jurassic times.

Armorella sphaerica. Sp. n.

(Pl. II, figs. 4-11.)

Stations 27, 31, 45, 123, 140, 144, 148, 149, WS33, 154, 334, MS68.

The description of the genus is sufficient for the species, which is very common at Station 144, common at 148, 149, frequent at 45 and 140, very rare at the remaining stations. The range of depth lies between 110-270 metres, except for a single specimen at WS334 in 3705 metres. There is a considerable range of size, the specimens reaching 1.2 mm. in diameter without tubes. An average size is about 1.0 mm. in diameter. Tubes average up to 0.3 mm. in length. There can be no doubt that the small individuals which represent the species at those Stations where it is rare are merely young or pauperate individuals.

The external texture varies to a lesser extent. In general, the sphere is smooth externally, owing to its homogeneous construction, but, occasionally, the animal incorporates sand grains, which, being larger than the thickness of the wall, project and give an unfinished appearance to the test.

The tubes vary enormously both in size and number. It is difficult to give a maximum, as a broken tube may leave little trace. Specimens with four tubes are common. The length of the tube has no relation to the size of the sphere, many large specimens have very short tubes and *vice versa*.

Sub-Family: Rhabdammininae.

Hippocrepinella. Gen. n.

Test free, monothalamous, irregularly cylindrical and sometimes curved, furnished with two terminal apertures. Wall thin, compared with the size of the large central cavity, constructed of extremely fine sand and mud with little cement, and generally without inclusion of larger particles; smoothly and neatly finished, but often exhibiting numerous fine transverse

wrinkles. It is probably flexible during life, but dry specimens are rigid, and fragile. Colour varying from white to very dark grey.

Although widely distributed round the coastline of South Georgia, *Hippocrepinella* is mainly characteristic of the Cumberland Bay area, the majority of the records being from stations in or near that bay. It favours the tenacious mud found in that area, although a few specimens have been recorded elsewhere on sandy bottoms.

Hippocrepinella appears to be nearly related to *Hippocrepina*. Indeed, but for the existence of the secondary aperture we should have had no hesitation in referring the specimens to that genus, as the wall of the test is very similar in character though more delicate. Also, owing to the finer materials employed in its construction, the surface of the test is smoother and more polished.

Of the two apertures one, which may be regarded as the principal oral opening, is always well defined and sometimes quite large, while the secondary or basal opening is usually inconspicuous, and sometimes only to be detected with difficulty.

There is little doubt that the test is flexible and extensible in life. The apertures probably expand for the absorption of food, and contract for its digestion, opening again for the rejection of the empty diatom valves which form its food. Diatom valves have been observed, inside the cavity, of dimensions larger than the aperture. This flexibility of the living test would also account for the curvature of some specimens and the transverse wrinkles observed in others.

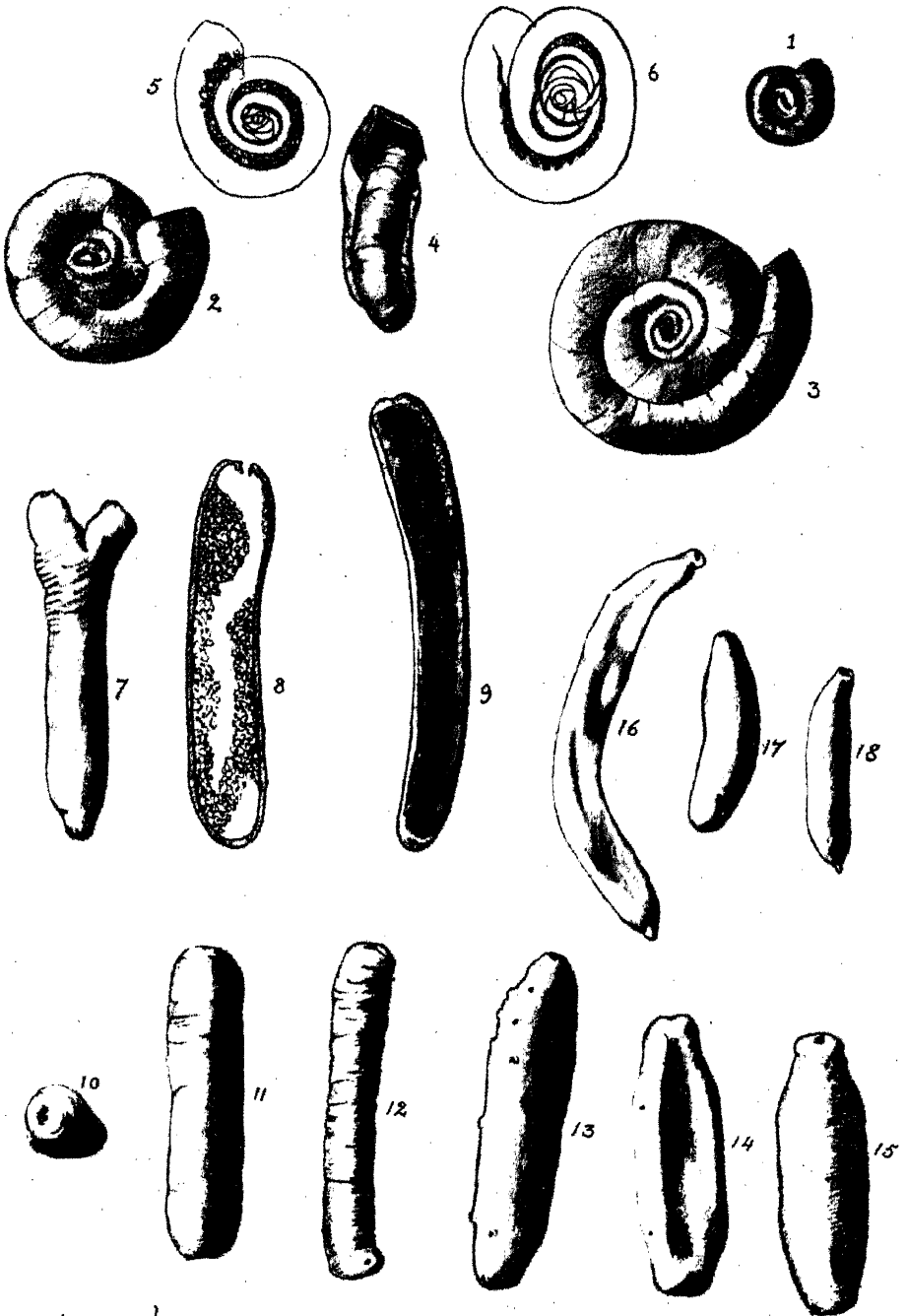
Hippocrepinella hirudinea. Sp. n.

(Pl. I, figs. 7-15.)

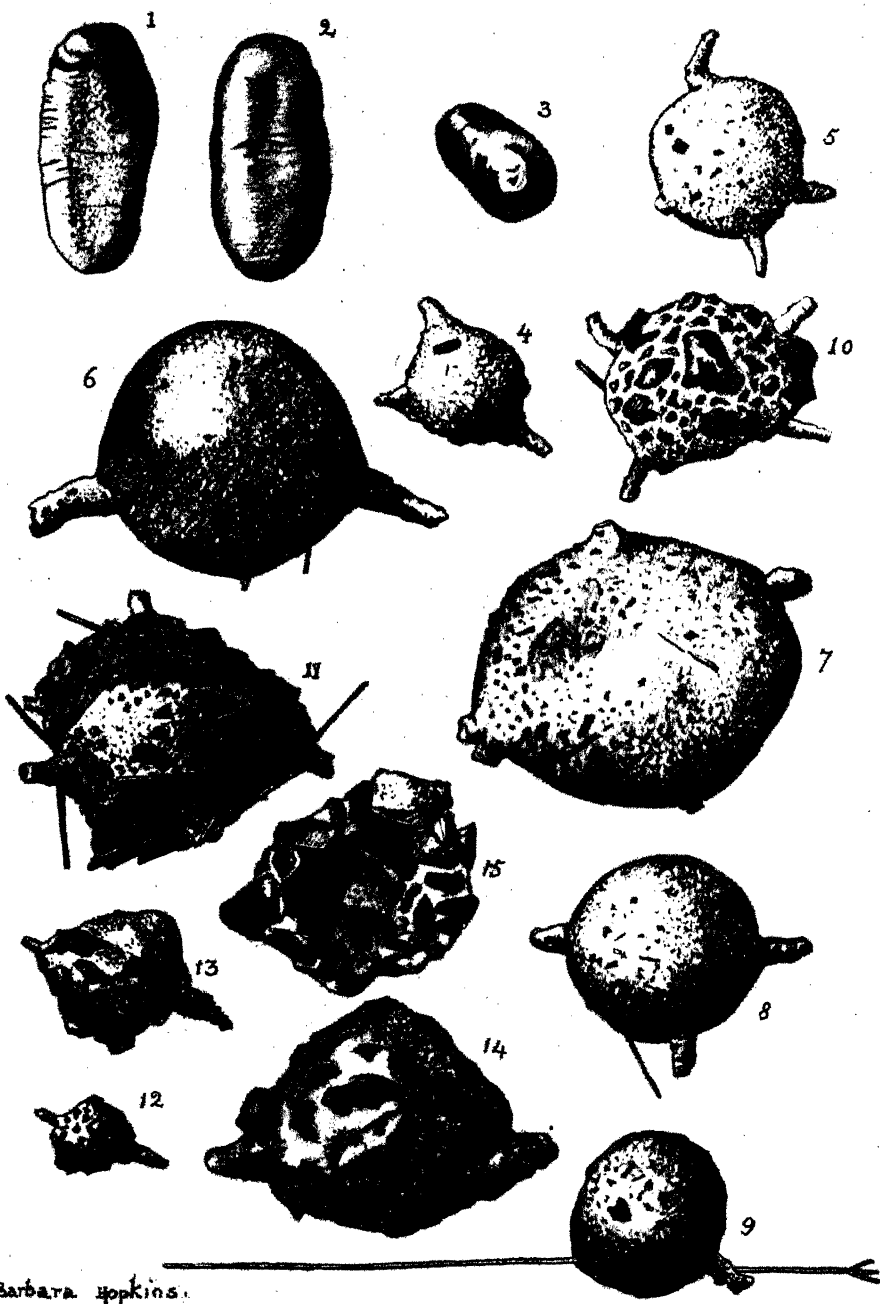
Stations 27, 28, 45, 123, 126, 140, 143, 144, 148, 149, MS68, WS28, 42.

Test free, monothalamous, irregularly cylindrical, occasionally curved, rounded at the extremities which are sometimes slightly clavate, at others tapered off. Wall thin, smooth and neatly finished, shining or "matt," often covered with fine transverse wrinkles. Apertures, central and terminal, usually varying in size, one being more pronounced than the other. Colour varying from light to dark grey. Size up to 2.0 mm. in length, 0.5 mm. in width.

This species, which is the genotype, is very variable in size and general appearance, while very constant in its specific features. Although many specimens are to be found in perfect condition, the majority exhibit compression, distortion, or shrinkage in varying degrees. The explanation is to be found in the condition of the interior of the test. We ourselves have laid open many tests, and Mr. J. T. Holder, F.R.M.S., has been so good as to cut serial sections of others, longitudinally. The cavity is found to be more or less compactly filled with an ingested mass of foodstuffs, principally diatoms,



Barbara Hopkin



Barbara Hopkins.

and it depends upon the compactness of this mass whether the test preserves its outline after death, or suffers distortion and compression. Mr. Holder's sections have also been useful in demonstrating the fineness of the material used in construction, and the almost total absence of larger particles of sand.

Occasional specimens noticed at several stations, notably 140 and 144, exhibit a number of irregularly placed pustular openings in the walls of the test, the origin of which is obscure. From the nature of the openings they are clearly not due to external agencies, but originate inside the test. They may be subsidiary openings for the emission of young individuals, but it seems more probable that they are made by minute organisms, perhaps Nemertine worms, which have been ingested with the mud mass as food, and have successfully eaten their way through the wall of their captor.

Hippocrepinella hirudinea is very common at Station 45 and common at 144 and 148, all of which are in or off Cumberland Bay. At the other Stations it is rare, or very rare. In depth the range extends between 100-346 metres.

An abnormal specimen found at Station 45 is bifurcate at one extremity, each of the arms bearing the usual aperture (fig. 7).

Hippocrepinella hirudinea. Var. *crassa.* Var. *n.*

(Pl. II, figs. 1-3.)

Stations 660, WS82.

General characteristics as in the species, but the test is much broader in proportion to its length; of an elongate oval or fusiform shape, round in section or compressed. Walls thicker and composed of coarser material, rough in texture, apertures inconspicuous. Length 1.2 mm. Breadth 0.5 mm.

The genotype *Hippocrepinella hirudinea* was not recorded at either of the Stations 660 and WS82. Its place appears to be taken by a form which we prefer to regard as a variety, rather than as a separate species, although its appearance is very distinctive, especially in the case of the specimens from Station 660, which is in Cumberland Bay. The specimens from Station WS82 are less rough. The organism is rare at both stations.

Hippocrepinella alba. Sp. *n.*

(Pl. I, figs. 16-18.)

7 Stations. 27, 45, 126, 144, MS68, WS83, 154.

Test monothalamous, cylindrical or fusiform, furnished with a large principal aperture on a produced neck, with or without a collar; a secondary basal aperture may be present; wall very smooth and of paper-like thinness, constructed of very minute particles without visible cement. Inner cavity

enormous compared with the thickness of the wall. Colour uniformly dead white.

Size very variable, the largest specimen being 0.3 mm. broad, 2.8 mm. long, and the smallest 0.52 mm. long and 0.09 mm. broad.

The foregoing is an attempt to describe an organism which, owing to its rarity and fragility, is represented by very few entire specimens, hardly any of which agree in all details, though all conform in the nature of the test.

The wall of the test is extremely thin in comparison with the size of the organism, and, owing to the absence of cement and the uniformly minute size of the particles employed in its construction (apparently fragmentary diatoms), is, when dry, fragile to the last degree. In life it is almost certainly flexible and distensible, but nearly all our specimens are more or less collapsed and broken.

The great variation in size probably represents stages of growth only, but in different specimens there is an equally remarkable range of form between broadly fusiform and elongate cylindrical.

The most striking point of difference in the specimens lies in the form of the aboral extremity. The principal aperture is always conspicuous and large on its more or less produced neck, and is sometimes furnished with a thickened collar. The secondary or basal aperture hardly exists, as such, at all. In many specimens the basal end is produced into a pronounced nipple, which may or may not be pierced; in other specimens it presents an unbroken rounded extremity.

These points of difference, especially the last mentioned, raise the questions (1) whether the specimens represent more than one species, and (2) whether they are proper to *Hippocrepinella*. We think the second point must be left for final decision when more material is available, but, having regard to the identical nature of the wall in all the specimens, and its probable plastic nature when living, we attach little importance to the variations in size and shape or even to the apparent suppression of the basal aperture.

Hippocrepinella alba is very rare everywhere, but a good many specimens, more or less fragmentary, have been obtained in all, the best Stations being 45, 144, MS68, and WS154. Its food consists of ingested diatom-mud as in the case of *Hippocrepinella hirudinea*.

Its range in depth extends between 100-270 metres.

DESCRIPTION OF PLATES.

PLATE I.

- Fig. 1.—*Gordiospira fragilis*.—Young individual, side view. $\times 40$.
Figs. 2-3.—*Gordiospira fragilis*.—Adult individuals, side view. $\times 30$.
Fig. 4.—*Gordiospira fragilis*.—Adult individual, edge-oral view. $\times 30$.
Fig. 5.—*Gordiospira fragilis*.—Young individual viewed as a transparent object to show the irregular coiling of the early chambers. Protoplasmic body dark. $\times 160$.
Fig. 6.—*Gordiospira fragilis*.—Young individual viewed as a transparent object to show the irregular coiling of the early chambers. Protoplasmic body, dark. $\times 80$.

- Fig. 7.—*Hippocrepinella hirudinea*.—Abnormal individual with bifurcate extremity. $\times 20$.
 Fig. 8.—*Hippocrepinella hirudinea*.—Thin section showing protoplasmic body loaded with diatoms. $\times 20$.
 Fig. 9.—*Hippocrepinella hirudinea*.—Opaque section. The variations in the thickness of the wall of the test at different places are due to the angle at which the section is cut. $\times 20$.
 Fig. 10.—*Hippocrepinella hirudinea*.—Oral end view. $\times 15$.
 Figs. 11–15.—*Hippocrepinella hirudinea*.—Side view illustrating variations in shape due to compression, shrinkage, etc. Figs. 13, 14, and 15 show accessory openings in walls, possibly due to parasites. $\times 20$.
 Figs. 16–18.—*Hippocrepinella alba*.—Side views of specimens of various sizes. $\times 20$.

PLATE II.

- Figs. 1 and 2.—*Hippocrepinella hirudinea*, var. *crassa*.—Side views. $\times 24$.
 Fig. 3. *Hippocrepinella hirudinea*, var. *crassa*.—End-oral view. $\times 24$.
 Figs. 4–8.—*Armorella sphaerica*.—To illustrate variations in size, number of tubes, etc. $\times 35$.
 Fig. 9.—*Armorella sphaerica*.—With incorporated sponge spicule. $\times 25$.
 Fig. 10.—*Armorella sphaerica*, using coarse material for construction. $\times 25$.
 Fig. 11.—*Armorella sphaerica*, using sponge spicules and coarse sand for construction. $\times 25$.
 Fig. 12.—*Pelosphaera cornuta*.—Young individual. $\times 9$.
 Figs. 13 and 14.—*Pelosphaera cornuta*.—Stages in development. $\times 9$.
 Fig. 15.—*Pelosphaera cornuta*.—A specimen laid open. The white lines between the sand grains indicate the highly finished surface of the incorporating cement, as contrasted with the rough external layer. $\times 9$.

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XI.—NOTE ON THE SUBSTAGE DIAPHRAGM.

By CONRAD BECK, C.B.E., P.R.M.S.

(Read November 18th, 1931.)

ONE TEXT-FIGURE.

TRANSPARENT objects when viewed under a low-power microscope are generally illuminated by a concave mirror, but when high powers are used, by a flat mirror and a condenser. These remarks refer to the illumination of low powers with a concave mirror and the use in connection with this of a diaphragm between the mirror and the object.

The regulation of the angle of illumination is recognized as being of such importance with high-power microscopy that the use of a substage condenser is always fully discussed. The use of a diaphragm with mirror illumination with low powers has not always received the attention it deserves.

Early writers on the microscope state that no microscope should be supplied without a diaphragm to limit the aperture, that is, the angle of the illumination. Later writers are less explicit, but explain that a diaphragm is generally supplied and do not say what it is for.

A diaphragm may be used for two purposes :—

- (1) To reduce the area of the object that is illuminated.
- (2) To alter the angle of light which passes through the object and thus to fill the aperture of the object-glass to a greater or less degree.

There does not appear to be any other function of a diaphragm. The actual intensity of the illumination should be controlled by other means.

As to the first use of a diaphragm, the reduction of the area of the object that is illuminated, if, for instance, the microscope is examining a field of view of 5 mm. and the mirror is illuminating an area of 50 mm., there will be reflections from the slip and cover glass which by glare and flooding tend to produce a misty image. The experience of this with wide-angle condensers is familiar to all, but the angle of the light which reaches the object from a mirror is small, and consequently the percentage of reflected light is small. Direct light incident on a glass surface has about 4 per cent. reflected, and this does not rapidly increase until the angle of the light exceeds 70°.

A 2-inch mirror 4 inches below the stage throws a beam of light of about 30° angle 0.26 N.A. upon the object, and although the effect of glare can just be noticed, it will be found to be so slight that we need hardly consider this function of a diaphragm, to reduce glare, as being of practical importance.

The second use of a diaphragm is of far more consequence. This limits

the angle of light which passes through the object and fills the aperture of the object-glass.

The full resolution of an object-glass will not be obtained unless the aperture is fully made use of. That is well established, but neither will the full resolution of an object-glass be utilized unless the eyepiece has sufficient magnifying power to render visible the detail that is in the image produced by the object-glass.

Suppose a $\frac{3}{8}$ -inch object-glass 0.26 N.A. is being used with a 2-inch concave mirror at 4 inches from the stage, the mirror will just fill the whole aperture of the object-glass with light and the maximum resolution of about 26,000 lines to the inch will exist in the image. To see this fine detail, however, an eyepiece magnifying about $\times 15$ is required, and if only a No. 1

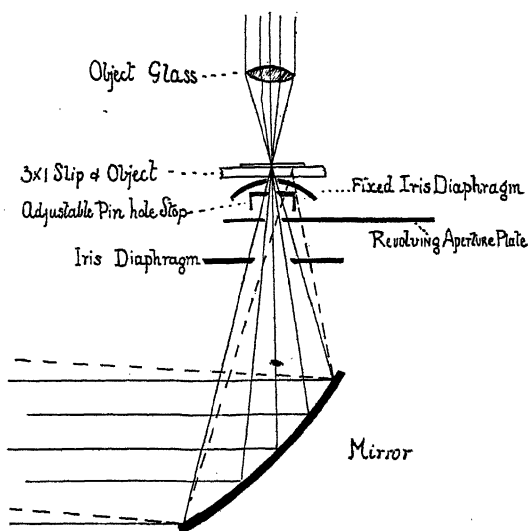


FIG. 1.

eyepiece magnifying, say, $\times 6$ is in use, there is no need to have this extra fine detail in the image for it cannot be seen. There is therefore no necessity to fill the whole aperture of the object-glass, and it is probably sufficient to use an angle of illumination of only one-third the angle to resolve everything that can be seen with this low magnifying power. In this case a diaphragm between the mirror and the stage may be used to reduce the angle without affecting resolution.

The advantage of reducing the angle of the illumination is not marked in stained specimens where the structure is revealed by the distribution of differently stained areas, but in semi-transparent or almost colourless objects it can scarcely be exaggerated. The structure or even the outlines of transparent objects are barely visible when illuminated with a wide angle cone of light, and the angle of illumination must often be restricted even below the amount required to give maximum resolution in order to show what is

desired. Therefore, the statement that a microscope should be provided with a diaphragm is justified and its chief, if not its only, object is to regulate the angle of the illumination that passes through the object. ✕

Four varieties of diaphragms are in general use: A small pinhole which can be moved backwards and forwards between the object and the mirror. This regulates the angle of illumination, but is generally made so small that due to the thickness of the slip it cannot be placed sufficiently near to the object to admit the maximum cone of light, and this maximum is sometimes required.

A revolving disc with different size apertures placed about $\frac{1}{2}$ -inch below the object also limits the aperture to definite angles according to the number and size of the apertures.

A third method is an iris diaphragm so made that it is fixed almost in contact with the under surface of the 3×1 slip. This does not limit the angle of light until it is so small that it limits the field of view. It limits the area of the field of view but does not limit the angle. If used over the top of a condenser it limits the angle of light coming from a condenser, but as a diaphragm for use with a mirror has no justification.

The fourth kind of diaphragm is an iris diaphragm at a considerable distance, say an inch or an inch and a half, below the object. This allows of a sensitive regulation of the angle of light and will be found to be the best form of diaphragm for use with a concave mirror. It does not limit the area of the field illuminated as definitely as a diaphragm nearer to the object, but this is a matter of minor importance.

XII.—ON THE CINEMATOGRAPHIC EXAMINATION OF SERIAL 778. 5. SECTIONS AS AN AID TO HISTOLOGY.

By P. R. PEACOCK and L. WOODHOUSE PRICE.

(From the Research Department, The Glasgow Royal Cancer Hospital.)

(Communicated by Mr. J. E. Barnard, May 18th, 1932.)

TWO PLATES AND ONE TEXT-FIGURE.

THE usual method of studying the histology of complex tissues, such as malignant tumours, is by means of a limited number of sections taken from selected portions of the tissue to be examined. Reconstruction by means of models, so successfully applied by embryologists, where discrete structures are being examined, is unsuitable for the study of most tumours owing to their complexity. It occurred to us that the examination of serial sections in rapid succession by means of the cinematograph would throw a new light on the morphology of such complex tissues. The ideal method, theoretically, would be to cut the entire mass of tissue into serial sections, to photograph each of these in order on a cinematographic film, and thereby to reconstruct the whole tissue.

APPARATUS.

The practical application of this method has been worked out by a series of experiments in micro-cinematography in which three different makes of amateur cinematograph cameras were tried out. The Bell and Howell 70 D Filmo camera was finally chosen as the most suitable for our purpose. The method consists in making a small number of exposures of each of a set of serial sections of the tissue to be examined, and projecting the pictures in rapid succession by means of a cinematograph projector. In this way successive planes are seen in rapid sequence and an idea of solidity is obtained. Owing to the technical difficulties involved any idea of utilizing the serial sections themselves, mounted on cinematograph film, or any other such system, was abandoned in favour of photography.

The apparatus consists essentially of an optical bench, a source of light (A), condenser (B), microscope (C-F), cinematograph camera (G), and a screen (I). (See fig. 1.)

Source of Light.—After preliminary experiments with ordinary filament lamps, Nernst filaments, carbon and iron arcs, the most satisfactory source

was found to be a Pointolite. A large condenser was used to project a parallel beam on to the substage condenser of the microscope, the mirror having been removed.

Microscope.—The microscope was aligned horizontally so that the ocular was in the optical axis of the light and the camera lens.

Camera.—The camera was arranged on a movable platform, pivoted at one end, so that it could be swung into optical alignment with the microscope, or swung out of line to allow the image to fall on the screen. An

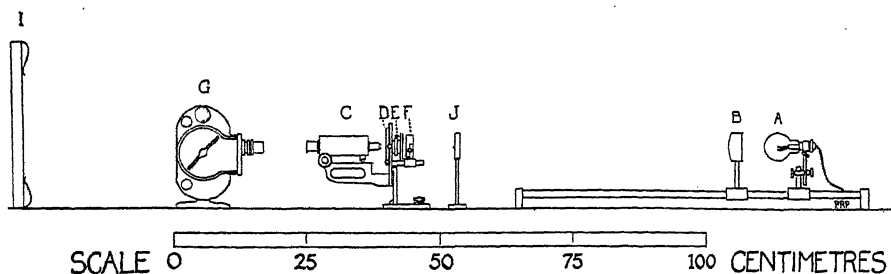


FIG. 1.

additional lens (H) is mounted on the platform so that it comes into alignment when the viewing screen is used and of such focal length as to give a sharp image on the screen without altering the focus of the microscope.

Screen.—The screen consists of a rigid frame with spring clips at top and bottom. A sheet of paper was held normal to the optical axis by the clips and served for the examination, focussing, and orientation of successive sections.

Filter holder.—J, carrying wratten B. and G. Filters.

TECHNIQUE.

The following technique has been found to give the most satisfactory results. The apparatus is aligned, and an image projected on to a screen consisting of a piece of undeveloped film placed in position in the frame of the camera. This is brought to a sharp focus under direct examination through a loup. The position of the microscope is then noted by taking a reading on the scale of the fine adjustment, and a small number of exposures is taken at this setting. Similar exposures are taken for a series of other settings on either side of this focus. The film is then developed, and, by an examination of the resulting images, the optimum setting for sharp definition is determined. The microscope is then set at this focus. The camera is now swung out of line and the screen so adjusted that the image is brought to a sharp focus by the lens (H) without altering the focus of the microscope. The screen is clamped rigidly in this position, and the apparatus is ready for use.

To photograph a series of sections all that is now necessary is to load the



FIG. 2.



FIG. 3.

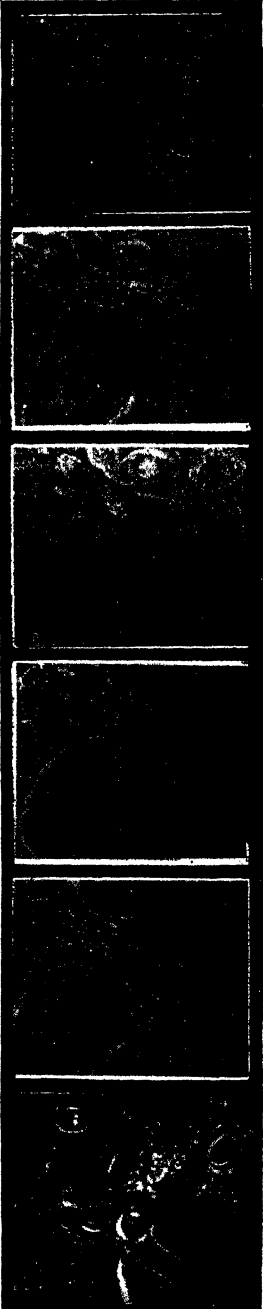
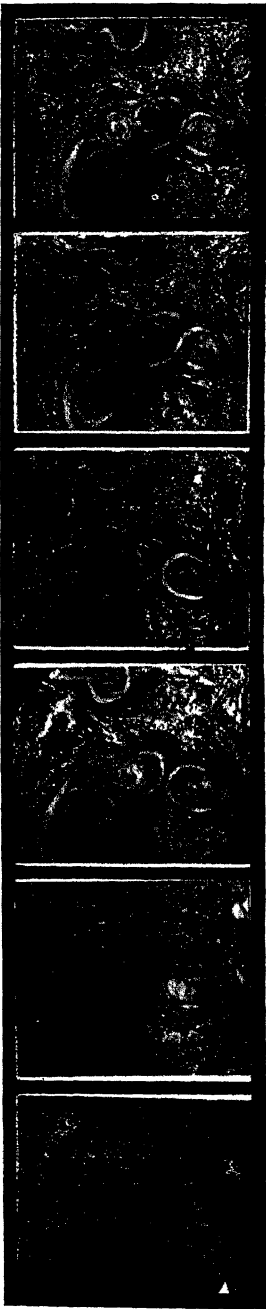


FIG. 4.

camera, place the first section on the microscope stage, suitably orientated, and by means of the fine adjustment to obtain a sharp image on the screen (I). The projected image on the screen is outlined in pencil to facilitate the orientation of subsequent sections, the camera is swung into position and an exposure is made. About seven exposures to each section gives a sufficiently smooth sense of continuity when the film is projected.

The next section is then placed in position, focussed so that its image on the screen coincides as nearly as possible with the outline of the first, and exposures are made as before. This is repeated with each section in turn until the whole series has been photographed.

From time to time it is necessary to make a fresh outline drawing on the paper screen (I) as the gross character of the serial sections begins to change.

The resulting film when complete is developed and reversed as a direct positive. Such a film, when projected, runs sufficiently smoothly to give a good sense of continuity, and it is only the technical difficulty of preparing serial sections free from distortion and the inherent imperfections of the apparatus which impair the perfectly smooth transition from one section to the next.

DISCUSSION.

To the best of our knowledge this method of reconstructive histology has not hitherto been described, but it would seem to have many obvious applications to the problems of pathology and embryology. Embryonic structures were selected for our earlier films, since the morphological arrangement of the tissues being reconstructed were already known and we were able to judge the value of the impressions created by the projected film. Our chief interest, however, is in the reconstruction of early malignant tumours in the hope of learning more of their origin and mode of spread in relation to the normal tissues. Several small primary squamous carcinomata have been studied and compared with normal and chronically inflamed skin. The most interesting point that has been rendered obvious by the study of these films is the morphology of typical cell-nests. In ordinary sections these usually appear as isolated clumps of keratinized cells separated from each other and from the surface of the tumour. In the reconstructed film, however, they are seen to be in direct continuity with each other and with the surface of the tumour. In other words they are part of the downgrowth of epithelium characteristic of squamous carcinoma and represent the horny layer in the confused and sponge-like structure that results from disorderly malignant growth.

The reconstruction of tissues by this method can be applied in several ways and it is important to decide at the start what is wanted. For example, in studying an embryo it is possible to ignore the relation of the viscera to the embryo as a whole and to keep one viscus always in the centre of the field. If this is done we get an idea of any transitions in the structure, e.g., from

squamous to columnar epithelium, but the shape and relations of the organ cannot be accurately estimated. On the other hand, where true relations are being considered it is obvious that the viscera will appear to move relatively to each other and to the field as the film is projected. Suitable titling during the course of the film ensures that the correct impression is obtained.

To achieve any useful results on the above lines will probably take a considerable time, but we have thought it worth while to advance this method in the hope that other research workers may find it useful.

LIST OF TITLES OCCURRING IN THE FILM

"CINEMATOGRAPHIC EXAMINATION OF SERIAL SECTIONS."

- Reconstruction of Tissues by Photography of Successive Serial Sections. An Experimental Film from the Research Department of the Glasgow Royal Cancer Hospital. Each subject consists of a series of from 400-800 sections. Thickness, $6\mu-8\mu$.
- Developing Eye of a 38-day Human Embryo. (Note the entry of the Optic Nerve and the Hyaloid Artery.)
- Normal Skin. (Note the appearance of Hairs, Sebaceous Glands, and Sweat Glands.)
- Edge of Ulcer on Lip, showing Epithelial Hyperplasia, Cellular Infiltration of Corium, and dilated Lymphatics.
- A General Survey of a Selected Section, obtained by moving the mechanical stage of the microscope.
- Squamous Carcinoma of Lip. (Note continuity between Surface Horny Layer and Cell Nests in deeper parts of sections.)

DESCRIPTION OF PLATES.

PLATE I.

- Fig. 2.—Serial sections of the eye of a 38-day embryo, showing hyaloid artery emerging from the optic nerve.
- Fig. 3.—Serial sections of a hair follicle and sebaceous gland to illustrate the continuity between the gland and follicle, which, in the first three sections, appear as disconnected structures.
(*Note analogy between the normal and malignant skin structures; i.e., hair follicle and cell nest, in figs. 3 and 4.*)

PLATE II.

- Fig. 4.—Serial sections of a keratinizing squamous carcinoma. Note the transitions illustrating the continuity between cell nests which appear to be isolated structures in some sections. The final picture is a low-power view showing the relationship of the group of cell nests photographed to the surface. A mass of keratinized tissue can be seen at X occupying a pit in the surface epithelium.

XIII.—A MICROSCOPE PROJECTOR FOR LECTURE PURPOSES. 778. 2.

By H. HARTRIDGE, F.R.S.

(From the Physiological Laboratory, St. Bartholomew's Hospital Medical College.)

(Read May 18th, 1932.)

ONE PLATE.

THE various forms of projection apparatus which have been previously designed are subject to the disadvantage that much time is taken in changing the eyepieces, in changing and focussing the objectives, and in changing and focussing the substage and auxiliary condensers. The microscope projector described in this paper has been designed to overcome these difficulties. By moving one handle an interchange of high- and low-power objectives, and high- and low-power condensers can be achieved simultaneously. By the movement of another handle the interchange of four eyepieces can be achieved.

THE OBJECTIVES AND EYEPIECES.

The steps of magnification as seen on the screen by an observer at a distance of 12 feet are as follows :

With the low power	...	...	8, 16, 32, and 64 diameters.
With the high power	...	...	125, 250, 500, and 1000 diameters.

At first sight it may appear faulty technique to use four eyepieces and only two objectives, and to change the magnification from 8 to 64 diameters with the low-power objective, and from 125 to 1000 diameters with the high power objective ; which is an eightfold change of eyepiece magnification. Thus, in an ordinary microscope with Huyghenian eyepieces, the lowest power eyepiece usually employed has a magnifying power of $\times 4$ or $\times 5$ diameters. Therefore, to obtain an eightfold increase of magnification, eyepieces of $\times 32$ or $\times 40$ diameters respectively would have to be employed. But objectives which would stand such high-power eyepieces would necessarily be costly and great care would have to be exercised in using them if adequate results were to be obtained. This difficulty has been met in the projector described in this paper by using a range of very low-power eyepieces, namely, $\times 1$, $\times 2$, $\times 4$, and $\times 8$. The range of magnification of one to eight is still obtained, while at the same time the highest power eyepiece is such that any reasonably good objective will give quite adequate definition. These four eyepieces

are made "parfocal," that is, when an objective is in focus with one it is in focus with them all. A further advantage of using low-power eyepieces is that a brighter image is thrown on the screen. This may be explained as follows: A two-thirds objective with a $\times 8$ eyepiece gives an image of the same magnification as does a one-third objective with a $\times 4$ eyepiece. But the latter produces a brighter image than the former because the objective has a greater numerical aperture. For the same reason, a one-sixth objective and a $\times 1$ eyepiece gives a brighter image than either. In other words, it is always preferable in projection, and in other cases where bright images are required, to use high-power objectives and low-power eyepieces. This is a further reason for the use of low-power eyepieces in this projector.

THE SLIDE AND THE MICROSCOPE STAGE.

In this projector the slide is placed on the stage with its cover-glass nearest to the objective, as in an ordinary microscope, but unlike an ordinary microscope, it is attached to the under side of the stage, that is, on the side near to the source of light. This position of the slide has four advantages: (1) the space between condenser and slide being greater than that between objective and slide, the changing of one slide for another is more easily carried out; (2) the slide is placed on the side of the stage which is illuminated by the light source used for projection, and this illumination facilitates the changing of the slides; (3) the thickness of the glass slide is of no consequence since the side of the slide on which the specimen is mounted is in contact with the stage. Therefore slides of different thickness are all in focus, and when once the objectives have been focussed for one slide they remain approximately in focus for other slides; (4) if an objective should accidentally come into contact with the slide, the latter is merely pushed away from the stage without damage to either objective or slide.

THE ILLUMINATION.

Although various light sources, such as the tantalum arc and the metal filament lamp, can be used for micro-projection, there is no doubt that the carbon arc has the advantage of giving brighter images. It has the disadvantage of requiring to be recharged with new carbons and of having to be adjusted. These operations are too well known to require description here. Adjustments are facilitated in this projector by the employment of a "view finder," in which an image of the carbons is thrown on to a ground glass screen which is readily seen by the operator. The light from the arc is rich in infra-red rays and ultra-violet rays. The former heat the specimen and the latter bleach it. These unwanted rays are removed in this projector, (a) by a water cooling trough, (b) by a trough filled with a saturated solution of ferrous sulphate, and (c) by a screen of didymium glass.

If necessary, contrast screens may be added in order to emphasize certain details in the specimens. When the low-power eyepiece is in use an excessively bright irregularly lit field was obtained. To remove this irregularity, and reduce the light, a ground glass screen is interposed between the arc and the substage condenser. When the high-power eyepiece is in use a less well lit field is obtained. To increase the illumination a switch is closed which increases the illumination by increasing the current taken by the arc lamp from 12 amperes to 20 amperes.

THE MICROSCOPE ADJUSTMENTS.

The microscope has six adjustments. (1) A focussing adjustment for the substage, (2) and (3) vertical and horizontal adjustments for the mechanical stage, (4) and (5) fine and coarse adjustments for the high-power objective, (6) a coarse adjustment for the low-power objective. So far as focussing is concerned the adjustments (4) and (6) are those most frequently in use. In order to avoid the operator trying to focus the low-power objective by means of (6), or the high-power objective by means of (4), screened electric lamps are fitted in boxes, and these lamps are switched on automatically by the movement of the handle A, so that when the high-power objective is in use adjustment (4) is illuminated, and when the low-power lens is in use adjustment (6) is illuminated.

THE ILLUSTRATIONS.

Figure 1 shows the complete apparatus from one side. It will be seen to consist of arc lamp with ammeter, cooling troughs, metal base-bar, and microscope consisting of (1) two substage condenser slides, (2) a mechanical stage having 3-inch horizontal and 1-inch vertical movement, (3) two microscope body slides, and (4) the eyepieces. These are all bolted down to the metal base-bar and correctly aligned.

Figure 2 shows a semi-side view. Handle "A" simultaneously changes the condensers and objectives, and handle "B" changes the eyepieces. The design of the lever system for changing the objectives has to be of such a nature that great precision of movement is obtained. This precision is obtained by the use of four slipping clutches, one to each objective and one to each condenser. Each objective has two stops: one limits its motion to the right and the other to the left. The condensers have similar stops. When the lever is moved one way the objectives and condensers move from right to left, come up against their stops and then slipping of the clutches occurs. When the lever is moved the other way the objectives and condensers move from left to right and again come up against their stops, when slipping of the clutches again takes place as before. In this manner four simultaneous movements occur, each one being limited by stops independently of the others. Thus after changing from the high power to the lower power

and back again to the high power, no refocussing is necessary and no adjustment of the mechanical stage is required, since the objective is still projecting the same part of the specimen as it was before the movements.

In fig. 3 the arrangement of levers actuating the condensers, objectives, and eyepieces can be seen. As these levers are moved the condensers and objectives, which are fitted with centring mounts, are brought into position opposite to each other and in correct optical alignment. The four eyepieces which will be seen mounted in square fittings are arranged to pass in turn before the objective in use.

This instrument is to be made by Messrs. W. Watson & Sons.

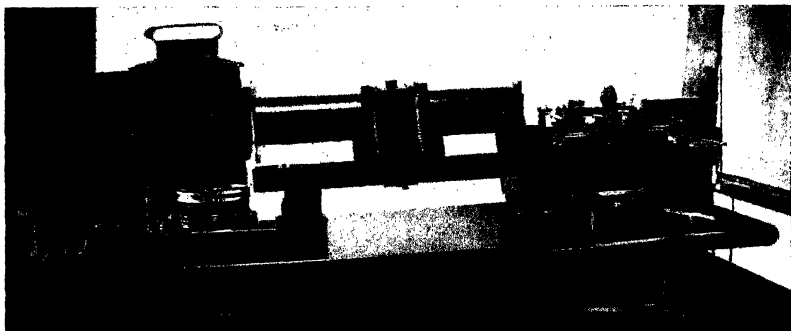


FIG. 1.

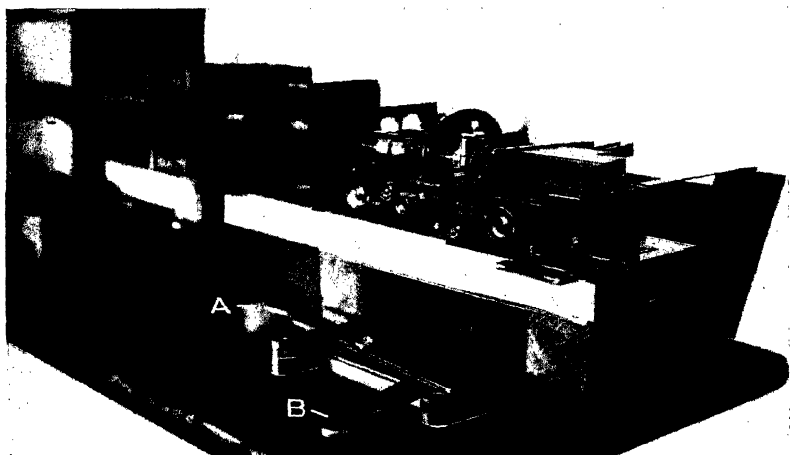


FIG. 2.

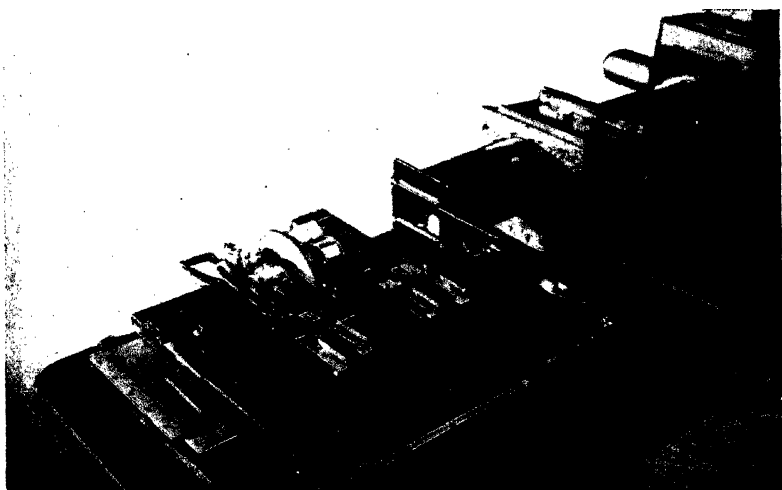


FIG. 3.

XIV.—A MICROSCOPE PROJECTOR FOR MAKING DRAWINGS. 778. 2.

By H. HARTRIDGE, F.R.S.

(From the Physiological Laboratory, St. Bartholomew's Hospital.)

(Read May 18th, 1932.)

THREE TEXT-FIGURES.

THE usual form of projection microscope for making drawings shown in fig. 1, has two disadvantages, (1) the operator has to stand up to make adjustments to the light source and condensers, (2) the image projected on the paper is dissimilar to that seen down an ordinary microscope—i.e., while

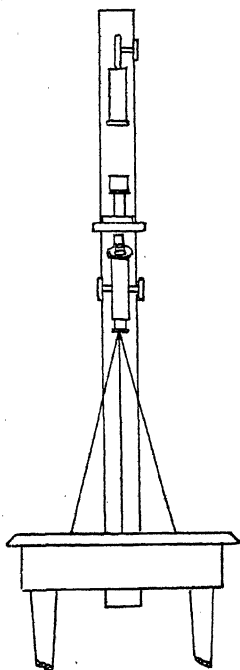


FIG. 1.

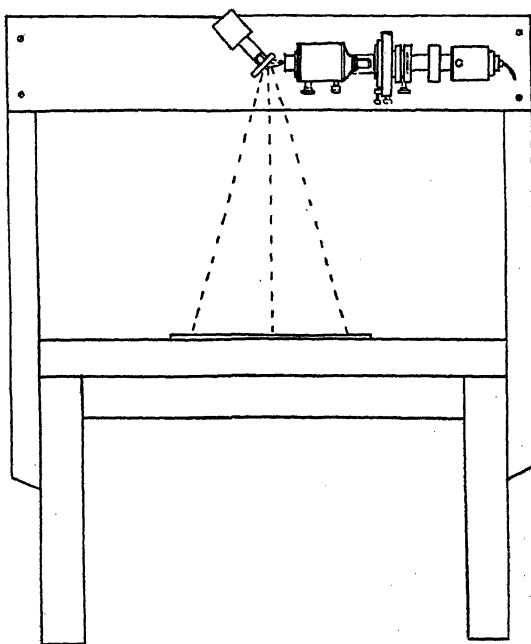


FIG. 2.

parts near to, or away from, the observer are in the same position as they are in an ordinary microscope, parts on the right are projected to the left and *vice versa*. (That is, the projection microscope forms a mirror image of that seen down an ordinary microscope.) The reason for this may be

explained as follows: In an ordinary microscope the eyepiece image lies between the objective and the observer; it is as if the objective were projecting an image on a screen and on the opposite side of the screen were placed the observer. In the projection microscope, on the contrary, the observer is on the same side of the screen as the objective. These two disadvantages are avoided by the projection microscope shown in figs. 2 and 3.

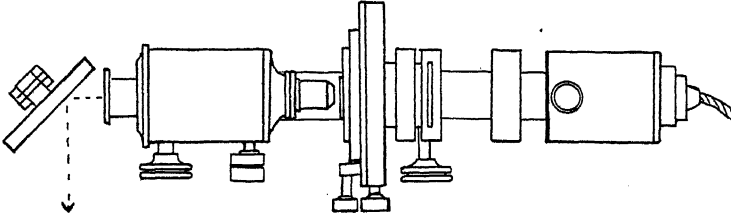


FIG. 3.

By causing the projected image to be reflected at the plane mirror, the image is reversed so that it becomes identical with that seen down an ordinary microscope. At the same time the optical axis of the microscope is changed from the vertical to the horizontal, thus bringing its milled adjusting screws within easy reach of the seated observer. For changing the eyepieces or for horizontal projection the mirror is temporarily swung upwards, and to the left, out of the way. The apparatus is made by Messrs. W. Watson & Sons from standard microscope parts.

XV.—THE INFLUENCE OF REFRACTIVE INDEX ON MOUNTING MEDIA.

535. 327.

By WILFRID MARSHALL, M.A., B.Sc., M.D.

(Communicated by Mr. W. E. Watson Baker, March 16th, 1932.)

HITHERTO the minute structure of biological tissues has been investigated chiefly by differential stains. Very little work has been done on the possible differentiation of tissue by varying the refractive index of the mounting medium, although forty years ago Dallinger (1891) wrote, "If, . . . we can discover media which will be of sufficiently high refractive index, and still tolerant of or non-injurious to organic tissues immersed in it, a new line of investigation may be open to histology and pathology." In petrology liquids of varying refractive index are often used more particularly to determine the refractive index of rock constituents and crystals. The principles involved in such observations were laid down long ago by Sorby (1877), Maschke (1880), and Thoulet (1879), and they were applied, apparently independently, by Stephenson (1880) to the mounting of diatoms. He says: "It may be demonstrated that the visibility of very minute structures is proportional to the difference between the refractive indices of the object and the medium in which it is mounted," and further: "It follows from this that when this difference = 0 or is very small the structure is invisible." In a later communication (1882), "On mounting Objects in Phosphorus and in a Solution of Bismuthide of Mercury," he refers to the visibility of muscle fibre in different media. "In water or glycerine (optically considered) it is well shown because the difference of refractive power is sufficient to depict the structure and not so great as to obscure the view, but mounted in Canada balsam, in which the two indices are so much nearer equality (balsam being less than muscular fibre), the image is so faint that we resort to polarized light if it be necessary to examine it under such circumstances"; and, referring to the solution of the double iodide, "For muscular fibre on the other hand a strong solution is not suitable since the high refractive power of the object approaches that of the medium and the resulting image is consequently very faint." A comment on this statement is made below.

The effect of a mountant on the appearance of a tissue may involve at least three factors, namely: (i) a possible alteration in the physical condition of the tissue; (ii) a difference in dispersion of the mountant and the tissue constituents; (iii) a difference in refractive index of mountant and the components of tissues.

(i) An alteration in the physical condition of a tissue occurs prior to

the process of mounting from the action of the fixatives usually employed, but further changes are possible owing to the action of the mountant itself. The same tissue has generally a different appearance in an aqueous mountant and one of the same refractive index consisting of an organic fluid, probably, in most cases, owing to differences in colloidal aggregation of the constituents of tissues in the two liquids. Soap in aqueous solution is colloidal, while in alcohol it forms a true solution; and, in a comparable way, some organic mountants may affect the lipid containing elements of tissues. All mountants of high refractive index do not diminish the visibility of muscle structure in the way described by Stephenson in the case of potassio-mercuric iodide solutions. In some respects the structure is enhanced by such media. The use of this solution serves to illustrate the point under discussion. Like most other soluble mercuric compounds it interacts with amino-compounds and is a very delicate general test for alkaloids. It also affects albumins. Added to blood serum it causes a precipitate which is dissolved by excess of the iodide, but is dissociated on addition of water with the formation of another precipitate, which in turn may be redissolved by excess of potassium iodide. Owing to this reactivity with proteins, potassio-mercuric iodide is unsuitable for histological work, and observations made with it require the greatest care in interpretation.

To take another example of a different kind of action, an eutectic mixture of chloral hydrate and camphor, owing to the former, has a marked clearing action on some tissues. Applied to a stained blood film it causes the red blood corpuscles to become invisible, leaving the white corpuscles apparently the sole occupants of the visual field.

(ii) The difference in dispersion of a mountant and its embedded tissue is of much less importance in the case of stained biological tissues than of petrological sections or crystals, but it is not altogether negligible. Organic liquids of high refractive index have usually a different dispersion from that of tissues, and this difference may be apparent in the preparation. Macroscopically the effect is well seen in spectral emulsions. Generally, however, effects of this nature are due less to differences in dispersion than to incorrect adjustment of the microscope. With high refractile mountants especially, as correct optical adjustment as is possible is essential for proper observation. This correction consists mainly, as will be mentioned presently, of shortening of tube length or its equivalent.

(iii) The effect of difference in refractive index has been referred to. It is concerned with the "outline picture" in an object. Assuming that a transparent uncoloured solid in a colourless liquid of the same refractive index is invisible, and that the measure of visibility of transparent substances is the difference in refractive index between them and their immediate environment, it would seem to follow that the degree of visibility would be the same for equal increments or decrements from the refractive index of such substance which may be termed the null point. And this deduction would be true if the transparent substance were part of a mathematical plane

bounded by mathematical lines ; but, as histological objects possess thickness, three dimensional space is involved, and this affects the appearance if not the visibility of structures at equal differences of refractive index above and below a null point. In the case of a highly refractile medium the rays of light converging to form critical lighting will be further refracted towards the axis in passing from the ordinary glass slide into the medium, whereas with a medium less refractile than that of the glass the light rays are refracted away from the axis. As a result strands of tissue, for example, appear broader and somewhat less defined in a medium of low compared with one of high refractive index. And it is obvious that, owing to the difference in refraction of the two media, strands slightly above or below the plane of sharpest focus will present a somewhat different appearance in the two cases. The picture in other words is not the same. It is further differentiated by the greater depth of focus given by the medium of high refractive index. This effect is of advantage in high-power photo-micrography, but it is perhaps most clearly exhibited in the greater stereoscopic effect obtained in high-power binocular microscopy. The differentiation of planes is interestingly brought out by comparing stained blood films mounted in low and in high refractive media. In a medium of low refraction the white blood corpuscles appear to be below the plane of the red corpuscles ; in a high refractive medium they appear to be above.

Another advantage of highly refractile media is the greater brilliancy of objects embedded in them under dark ground illumination ; and the effect is enhanced by the use of a highly refractile medium between condenser and slide. The effect is due to more light rays striking particles at glancing incidence, owing to their greater refraction in the medium, and being reflected into the objective.

The most obvious effect, however, of highly refractile mountants is the greater visibility conferred on connective tissue, the refractive index of which, in the fixed state, is approximately 1.55. This result often gives to the visual field a sense of greater completeness. Sections of myxomata, gliomata, and similar tumours, in consequence show up well in mountants of high refractive index. The intercellular processes and the fibrils of epidermal cells, Hensen's line in striped muscle, and eleidin granules in cells are also more clearly seen. In stained blood films the red corpuscles and the nuclei and intracellular granules of white corpuscles are more sharply defined, but in unstained blood films the only noticeable effect of highly refractile mountants is the increased visibility of the red corpuscles and especially of the distortions due to drying. An appearance of central vacuolation is often noticeable. Malarial parasites in stained films seem to be more easily found than in Canada balsam mounts, but in unstained films parasites are not easily found even in the most highly refractile media. For bacteriological purposes, however, a highly refractile medium does not seem to be advantageous. Well-stained bacilli stand out more sharply, it is true, but an appearance of spore formation is often conveyed which does not exist.

The investigation seems to show that media of high refractive index are likely to find only a limited sphere of usefulness in histology. Wide variations in the refractive index of a mountant from that of the slides in common use introduce conditions which seriously affect resolution and which are not greatly minimized by the use of slides of highly refractive glass. The highest refraction of a mountant likely to be of use in histology may be put at 1.70, and for mountants approaching this refractivity specially computed objectives are desirable. Without these the ordinary laboratory microscope stand cannot be used with success. A high refractive index of the mountant has an effect comparable to that of a thick cover-glass and the tube length has in consequence to be shortened, often considerably. With a 4 mm. objective having a correction collar and corrected for a tube length of 250 mm., it has often been found impossible to get a clear picture of a section in a mountant of μ 1.80 under a No. 1 cover-glass with the correction collar adjusted for the thickest cover-glass and the draw-tube fully pushed in, giving a tube length of 175 mm. It is obvious that with the ordinary laboratory stand and objectives corrected for 160 mm. tube length, even approximate adjustment for highly refractile media is impossible. This effect may, of course, be minimized by having section and mountant as thin as possible.

The media investigated were numerous and varied in refractive index from 1.33 to 2.00. Besides the usual mountants they included a mixture of chloral hydrate and camphor and several other eutectic mixtures of different refractive indices, aqueous solutions of potassio-mercuric iodide and other substances, and various pure organic compounds. The refractive index of the media employed was taken with a Zeiss-Abbe refractometer for media up to μ 1.68. For media of higher refractive index a Pulfrich refractometer, kindly lent by Prof. Findlay, was used.

Owing to the different effect on cellular contents of aqueous and organic mountants it is desirable, for the purpose of studying the influence of refractive index, to compare the groups separately. Unfortunately there are no aqueous solutions of high refractive index adaptable as mountants of organic tissue. Double iodides have been referred to. (It may be remarked that the refractive index of saturated solutions of potassio-mercuric iodide is very variously given, a result which must be due to its having been taken at different temperatures since its solubility increases very rapidly with increase of temperature. On standing at ordinary room temperatures it does not usually exceed 1.62.) Observations have in consequence been made mainly on organic mountants. In this group, on the other hand, it is difficult to find suitable mountants of low refractive index. Acetone, methyl, and ethyl alcohols (approximate μ 1.36) are too volatile and remove the stains of tissues. The butyl alcohols are more convenient and iso-butyl alcohol (μ 1.39) was much used. Cellulose varnishes are still more convenient and can be used for permanent mounts if proper care be taken. Durofix, used for repairing broken porcelain, etc., has a refractive index of 1.414, somewhat more when dry, and is a useful preparation. Unfortunately on drying it

contracts powerfully. A section, after passing through absolute alcohol is washed with amyl acetate and Durofix applied. A cover-glass is then gently pressed on until the mountant reaches nearly to the edge. If it reaches the edge the subsequent contraction will cause internal tears and the mount will be spoiled.

Of the mountants of relatively high refractive index that were used only monobromnaphthalene, methylene iodide, phosphorus, and the recently introduced Hyrax require notice. It may be mentioned, however, that piperine ($\mu 1.70$) was extensively investigated, but in no combination did it prove a satisfactory medium. In all mixtures used, having a refractive index above 1.55, some piperine eventually crystallized out.

Monobromnaphthalene and Hyrax were the most satisfactory of the highly refractile mountants since neither of them appears to react with fixed tissues. Monobromnaphthalene, being liquid and slightly volatile, necessitates the mount being ringed if permanency is desired. Hyrax, which is considered below, requires no protection.

Methylene iodide ($\mu 1.74$) is a somewhat unstable and reactive substance. It forms double compounds with certain metallic salts like silver nitrate, and consequently it tends to decolorize silver stained preparations; and it frequently alters the tint of other stains. It dissolves some metallic iodides and sulphides and also sulphur and phosphorus with an increase in the refractive index of the solution in each case. The best solution is one saturated with sulphur and warmed with a little arsenious sulphide until it assumes a canary-yellow colour. On filtering it forms a clear fluid ($\mu 1.81$) and has been kept in a stoppered bottle unchanged for over two years. If used as a mount protective ringing is essential.

Phosphorus, apart from the difficulty of its manipulation, is an impossible mount for organic tissues, partly owing to destruction which rapidly occurs, and partly because its high refraction prevents even an approximation to correct optical adjustment for observation. A saturated solution in methylene iodide, filtered, is easier to manipulate and is more stable, but it also eventually causes destruction of tissue.

Hyrax, as sold, has a refractive index of 1.654; after evaporation of the solvent the refractive index increases to 1.80. In this state it is a soft solid capable of being cut with a knife and liquefies on heating. For the purposes of the investigation it has been used chiefly in this state, the sections having been previously cleared in monobromnaphthalene. A syrupy solution in monobromnaphthalene has a refractive index of 1.69. Solid Hyrax also dissolves in cedar wood oil, a syrupy solution having a refractive index of 1.625.

Other mixtures that may be mentioned as useful are: Canada balsam, dried, 3 parts, monobromnaphthalene, 2 parts, a thick syrup ($\mu 1.59$); Canada balsam and monobromnaphthalene equal parts, a thin syrup ($\mu 1.602$); Styra^x in monobromnaphthalene to a thin syrup ($\mu 1.623$).

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ABSTRACTS AND REVIEWS.

ZOOLOGY.

(Under the direction of G. M. FINDLAY, M.D.)

HISTOLOGICAL TECHNIQUE, STAINING, ETC.

The Demonstration of Mitochondria.—J. R. BAKER ("A New Method for Mitochondria," *Nature*, 1932, 130, 134). Quinone (parabenzquinone) has an intense fixative action on mitochondria. The tissues are treated for an hour in quinone dissolved in saline then transferred to any other fixative such as Bouin's or Carnoy's fluid. The quinone may be at any concentration, from 0.05 p.c. for delicate tissues such as kidney to 0.5 p.c. for liver, but if the latter concentration is used the saline should be 0.1 p.c. less concentrated than usual. One may stain with iron-haematoxylin or by Altmann's or Benda's method. In using Altmann's method a convenient differentiator is 1 part of absolute alcohol saturated with picric acid to 7 parts of 30 p.c. alcohol used cold. G. M. F.

The History of Staining.—H. J. CONN and R. S. CUNNINGHAM ("The Use of Dyes as Vital Stains," *Stain Technol.*, 1932, 7, 81-90). The history of intravital staining is far older than the staining of fixed tissues. In fact, while the Chinese are said to have been familiar with the colouring of living tissue from very ancient times, the first recorded use of a vital dye goes back to 1567 when Antoine Mizaud, a French physician, recommended the employment of madder for staining the bones of animals feeding on that plant. The scientific introduction of vital dyes was, however, largely due to Ehrlich (1885-94) and his pupils, H. Ribbert (1904), and Goldmann (1909), who worked especially with pyrrhol blue. The vital staining of leucocytes was first introduced by Certes (1881), who employed cyanine and quinolene blue for the differential staining of frog's leucocytes and noticed that they retained their motility for a short time, while taking up the dye. G. M. F.

The Marchi Method for Degenerated Nerve Fibres.—F. A. METTLER ("The Marchi Method for Demonstrating Degenerated Fiber Connections within the Central Nervous System," *Stain Technol.*, 1932, 7, 95-106). The following modification of the Marchi method is recommended. After preliminary hardening in 10 p.c. neutral formaldehyde for 24 hours the tissues are cut into parallel slices 4 mm. in thickness and removed directly to an abundance of 3 p.c. potassium bichromate aqueous solution which has been aged for 3 months but has not been reduced to a green colour. Here the tissue remains for 2 weeks and is then placed in about four times its own volume of the Marchi mixture, which is made up of equal parts of 3 p.c. potassium bichromate and 1 p.c. aqueous solution of osmic acid. The time of action of this solution depends on the size of the tissue, varying

from 5 to 14 days. The Marchi fluid is examined periodically and more osmic is added if necessary—the presence of osmic acid can be detected by the smell. After removal from the Marchi fluid, the tissue is washed in water for 24 hours and then embedded in celloidin. The sections are usually cut dry at about 40μ , stored in 50 p.c. alcohol, and after dehydration are cleared in carbol-xylol and mounted in carbol-xylol balsam. In obtaining material for examination from animals it is best to kill by coal-gas. Migration of the Marchi particle is explained on the basis of phagocytosis. G. M. F.

The Demonstration of Nerve Terminations in the Skin of the Hand.—

M. R. MARTINEZ PÉREZ ("Contribution à l'étude des terminaisons nerveuses dans la peau de la main," *Trav. Lab. Rech. Biol. Madrid*, 1931, 27, 187–226). The procedure recommended for the demonstration of nerve endings and Meissner's bodies in human skin is as follows: Place slices 3–4 mm. thick in a 10–15 p.c. aqueous solution of chloral hydrate for 24 hours. Rinse in distilled water and fix in absolute alcohol for 24 hours, add 4 drops of ammonia to every 60 c.c. of alcohol. Rinse in distilled water till the objects sink. Transfer to a 1.5 p.c. solution of silver nitrate for 7–8 days at 37°C . Reduce in formol pyrogallie acid in 24 hours. G. M. F.

A New Method of Demonstrating Chromosomes in Insect Eggs.—

M. L. SCHMUCK and C. W. METZ ("A New Method for the Study of Chromosomes in Entire Insect Eggs," *Science*, 1931, 74, 600–1). Good results have been obtained with the eggs of the fungus gnat, *Sciara coprophila*, which are 0.2 mm. in length and 0.1 mm. in thickness. The procedure, however, would probably work with larger eggs. The eggs are fixed for $\frac{1}{2}$ –2 hours in Carnoy's fluid, then washed for about 2 hours in several changes of absolute alcohol, passed through descending alcohols (1 hour each in 95, 85, and 70 p.c., and 30 minutes each in 50, 30, and 15 p.c., and washed in several changes of water. Place in cold normal HCl for 15 minutes and transfer to a similar solution heated to 60°C . for from 3 to 10 minutes. Rinse in the cold HCl and place in SO_2 water for from 2 to 5 minutes. Stain in fuchsin-sulphurous acid for 1 hour, wash in two changes of SO_2 water, and rinse in several of tap water. Dehydrate rapidly, clear in xylol and mount in balsam or between cover-glasses, which when moved suffice to turn the egg. It is important that the HCl and SO_2 solutions should be fresh, while the fuchsin sulphurous acid solution should be amber colour. G. M. F.

The Staining of Bacterial Flagella.—W. E. MANEVAL ("The Staining of Flagella of Bacteria, with Special Reference to Mordants," *J. Bact.*, 1931, 21, 313–21). An investigation into the composition and action of twenty-four mordants used for staining flagella is described. There appears to be little to choose. The following method for staining bacterial flagella was the most satisfactory: it involved the use of an aniline-alcohol-fuchsin—10 p.c. alcohol sol. basic fuchsin, 10 c.c.; aniline oil and alcohol, 1:3, 5 c.c.; 4 p.c. acetic acid, 1 c.c. distilled water, 30 c.c. The slides, dried in air, are placed on a level surface, treated with 4–8 drops of mordant for 2–10 minutes; are washed in 6–10 changes of water; after draining 3–5 drops of stain are applied for as many minutes. They are then washed thoroughly and dried. G. M. F.

The Addition of Glycerine to Bacterial Dyes.—F. M. HUNTOON ("Glycerin as an Adjuvant to Bacterial Dyes," *Am. J. Clin. Path.*, 1931, 1, 317–9). The addition of glycerine to dye solutions aids in the keeping properties and at the same time increases the clearness of the microscopical picture. For Gram staining mix

15 parts of 3 p.c. solution of crystal violet in 95 p.c. alcohol with 85 parts of 30 p.c. aqueous solution of glycerine. Counter-stains may be: (1) *Red*. Mix 10 c.c. of carbol-fuchsin with 100 c.c. of a 25 p.c. aqueous solution of glycerine. (2) *Brown-yellow*. Shake up 2 gm. Bismarck brown in 100 c.c. of water and filter. To the filtrate add 30-40 c.c. of glycerine and mix. The technique is the standard Gram's staining method. For staining tubercle bacilli in sputum two methods are employed: (1) The above crystal violet solution is used: if accidentally boiled the stain does not precipitate; (2) Glycerine carbol-fuchsin (5 p.c. phenol, 75 c.c.; glycerine, 25 c.c.; saturated alcoholic solution of basic fuchsin, 10 c.c.) or glycerine methylene blue (25 p.c. aqueous solution of glycerine, 100 c.c.; 1 p.c. solution of sodium hydrate, 1 c.c.; saturated alcoholic solution of methylene blue, 10 c.c.) may be used to give the usual red-blue contrast. G. M. F.

Gram-positive and Gram-negative Bacteria in Tissue Sections.—

J. H. BROWN and L. BRENN ("A Method for the Differential Staining of Gram-positive and Gram-negative Bacteria in Tissue Sections," *Bull. Johns Hopkins Hosp.*, 1931, 48, 69-73). Paraffin sections are stained for from 2 to 5 minutes in freshly filtered alum-hæmatoxylin (Harris). They are then washed in acid alcohol (3 p.c. HCl in 95 p.c. alcohol) till light pink, in ammonia water (1 p.c. aqueous ammonia in 100 c.c. water) till blue, and finally in water. Stain for 2 minutes in freshly prepared alkaline gentian violet (5 drops of 5 p.c. aqueous NaHCO_3 , with 0.5 phenol, added to 0.75 c.c. of 1 p.c. aqueous gentian violet). Wash with water and apply Lugol's iodine solution for 1 minute. Wash with water and blot. Stain 5 minutes with 0.005 p.c. aqueous rosaniline hydrochloride. Wash in water, blot, but do not allow sections to dry. Pass through acetone, then place on the slide 0.1 p.c. picric acid till the section becomes yellowish-pink. This is a critical point and the process should be carried out with the slide over a white plate or dish. Pass through acetone, acetone and xylol in equal parts, and xylol. Mount in balsam. Results: cell nuclei dark reddish-brown; cytoplasm yellowish; Gram-positive bacteria deep violet or almost black; Gram-negative bacteria bright red; cytoplasm of leucocytes yellowish; basophilic granules red; red blood cells yellow to red; cartilage pink. G. M. F.

The Pyridine Soda Method for the Impregnation of Mesoglia and Reticulo-endothelial Cells in Gelatine and Celloidin Sections.—

W. K. BELEZKY ("Die Pyridinsodamethode zur Imprägnation der Mesoglia (Hortegazellen, Oligodendroglia, Drenagzellen) und Reticuloendothelzellen (für Gelatin und Celloidin-Schnitte)," *Virch. Arch. Path. Anat.*, 1931, 282, 214-24). For gelatine sections fresh material is fixed in 5-10 p.c. formalin: wash under tap water for 24 hours. Transfer to 24 p.c. gelatine in 10 p.c. phenol for 2-3 hours at 37° C. in a covered watch-glass. Cool for not more than 30 minutes. Cut small pieces around the borders and fix for from 2 to 5 days, preferably in 10 p.c. neutral formalin or else in 10 p.c. acid formalin (pH 1.6-1.7). If necessary pass through an acid solution after fixation in neutral formalin. Sections are cut 10-25 μ in thickness and passed through a few changes of distilled water. Prepare the following solution: to equal parts of normal AgNO_3 and normal Na_2CO_3 in a watch-glass, add enough pyridine to dissolve the precipitate. The resulting reaction is about pH 9.4; for embryonic tissues better results are obtained with a less alkaline reagent. Impregnate from a few seconds to 2 minutes or more if dilute solutions are used. Pass through distilled water and transfer to 10 p.c. neutral formalin. The blackening should take about 5 minutes, and if too rapid, acid instead of neutral formalin should be added. Rinse in water and examine wet. Transfer to an albumen-smeared slide, dry, and mount. G. M. F.

The Technique of Blood Examination.—W. F. HARVEY and T. D. HAMILTON ("Studies on Blood and Tissue Reactions. I. Notes on Technique of Blood. II. The Differential Blood-cell Count," *Edin. Med. J.*, 1932, 39, 285-310, 3 text-figs.). Valuable notes on the making of blood films are given in the first of these papers. As a film spreader celluloid of 0.22 mm. thickness is preferred. Small smears are recommended containing about 275 leucocytes, so that every leucocyte in the film may be counted. "The leucocyte index" is defined as "the ratio of the granulocyte to the non-granulocyte leucocytes expressed as a percentage of the former." In the second paper it is concluded that the differential cell count on a well-made and to a surprising extent on an ill-made film is significantly valid for diagnostic purposes. There is evidence of long-wave diurnal oscillation of leucocyte numbers and proportions, but not sufficient evidence of a superimposed periodic short-wave type of fluctuation. All sorts of factors, such as sleep, posture, heat and cold, muscular exercise, locality of examination, digestion, and simple ingestion, may be regarded as traumata and may produce leucocytic variation of greater or less duration and may combine together to enhance or to mask the variation due to any one factor singly. G. M. F.

Cytology.

Spermatogenesis of Gerris.—A. W. POLLISTER ("Cytoplasmic Phenomena in the Spermatogenesis of Gerris," *J. Morph and Physiol.*, 1930, 49, 455-507, 6 pls., 1 text-fig.). In the spermatogenesis of Gerris the cytoplasmic components behave in general in the manner described in the Pentatomidæ. During the spermatocyte growth period the chondriosomes undergo considerable increase in mass. During the maturation divisions the chondriosomes are very constant in orientation with respect to the centrioles. The nebkern arises by fusion of chondriosomes differentiated into chromophilic and chromophobic portions. The Golgi bodies of the earlier spermatocytes are vesicular bodies, the peripheries of which are osmiophilic. Only the osmiophilic part of the Golgi masses is involved in the fragmentation to form dictyosomes. There is suggestive evidence that the process of acrosome synthesis largely takes place inside the sac-like acroblast (Golgi apparatus). In the spermatid, material which stains, in fresh preparations, like the acroblast is never seen, except inside or attached to the acroblast, where it appears in the form of small spheres of "pro-acrosomic" material which fuse to form the acrosome. G. M. F.

The Formation of Double Nucleoli in Lumbriculus.—L. P. SAYLES ("Double Nucleoli and Mitosis in Cells of the Alimentary Tract of Lumbriculus following Dilution of the Body Fluids," *J. Exp. Zool.*, 1930, 58, 487-94). The injection of distilled water into the coelom of Lumbriculus causes in the gut cells near the point of injection several hundred double nucleoli and a correspondingly large number of mitoses. G. M. F.

Studies on Euglypha.—R. P. HALL and J. B. LOEFER ("Studies on Euglypha. I. Cytoplasmic Inclusions of *Euglypha alveolata*," *Arch. Protistenk.*, 1930, 72, 365-76, 14 text-figs.). Mitochondria and neutral-red globules (vacuome) are described. Elements of the vacuome—globules scattered principally in the "alveolar zone"—are stained vitally with neutral red and are blackened in osmic and silver impregnation. The origin of reserve shell-plates is traced to small inclusions of the "granular zone." There is no evidence that the shell-plates arise either from mitochondria or vacuome. G. M. F.

Somatic Mitosis in Man and Animals.—T. KEMP ("Über die somatischen Mitosen bei Menschen und warmblütigen Tieren unter normalen und pathologischen Verhältnissen," *Ztschr. f. Zellforsch. u. Mikrosk. Anat.*, 1930, 11, 429-44, 27 figs.). The number of chromosomes in the somatic cells of man and chickens is usually constant but it is still possible that slight variations may occur in normal tissues: abnormal mitosis is rare. Atypical mitoses are common, however, in various pathological tissues such as benign tumours, regenerative and inflammatory tissues, though variations in chromosome number were not observed. Chromosome counts made in Rous' chicken sarcoma and in tissue cultures of an adeno-carcinoma of the mouse confirmed the occurrence of mitoses with varying numbers of chromosomes. G. M. F.

The Effect of Heat on Mitosis.—W. KOKOTT and E. GOLDMANN ("Zur Frage des Einflusses erhöhter Temperatur auf die Mitosen in Gewebeskulturen," *Ztschr. f. Zellforsch. u. Mikrosk. Anat.*, 1930, 11, 484-90). Mitosis is checked at 42-50° C., cells in telophase being especially affected and the readiness to initiate new processes is paralysed. G. M. F.

The Golgi Apparatus in the Cartilage Cells of Necturus.—A. B. DAWSON ("The 'Zone of Golgi' in the Cartilage Cells of Necturus," *Anat. Rec.*, 1931, 48, 379-97, 2 pls.). In supravital preparations the zone of Golgi appears as a homogeneous area of cytoplasm in which bodies stainable with neutral red and filaments stainable with Janus green B are grouped. Bodies stainable with neutral red also appear in certain osmic impregnations as blackened granules. Since such preparations may be obtained in tissue from animals not previously treated with neutral red, these bodies are undoubtedly pre-existent. Filaments which occupy the zone of Golgi are usually discontinuous and do not form a closed network. They react more or less specifically with osmic acid and silver nitrate, but may be demonstrated also by several mitochondrial methods. In mature cells they are indistinguishable morphologically from the filamentous mitochondria of the rest of the cytoplasm. The zone of Golgi usually occupies a definite area within the cell. In young flattened cells it is found near one pole of the nucleus. In the more rounded deep-lying cells it has a juxtanuclear position and is found on the side away from the surface of the cartilage. G. M. F.

Intracellular Symbiosis.—T. EKBLOM ("Cytological and Biochemical Researches into the Intracellular Symbiosis in the Intestinal Cells of *Rhagium inquisitor* L.," *Skand. Arch. Physiol.*, 1931, 61, 35-48, 4 pls.). Secretion in *Rhagium* larvæ is brought about by the discharge of plasma globules from the distal ends of intestinal cells. Mitochondria seem to aid in the formation of the secretory drops, though the Golgi-net could not be definitely related to secretion. The cells bearing the symbionts are directed towards a central lumen which connects with the main intestinal channel. The yeasts are located in the distal parts and are of variable size and shape. They migrate out singly and independently of globules. Both Gram-positive and Gram-negative strains are present. Gemmation is common but not mycelial formation. G. M. F.

The Action of Radium.—B. D. PULLINGER ("Causes of Cell Death in Irradiated Human Tissue," *J. Path. and Bact.*, 1932, 35, 527-40, 3 pls.). Observations on human tissues irradiated with X-rays and radium confirm the results obtained by Bashford, Murray and Cramer (2nd Sc. Rep. Imp. Cancer Research Fund, 1905) working on mouse tumours. Hyperæmia is an essential reaction to therapeutic irradiation with radium and X-rays. Thin-walled loosely

supported capillaries and veins are most readily affected and react in deep structures as well as at surfaces. If endothelial injury follows excessive distension, hyperæmia is succeeded by exudation of serum, extravasation of blood, and intra-vascular thrombosis. All effects following irradiation are related to these two phases, namely, vascular stimulation and vascular degeneration. G. M. F.

The Biological Action of Monochromatic X-rays of Different Wavelength on the Egg of Ascaris.—A. DOGNON ("Action biologique de rayons X monochromatiques de différentes longueurs d'onde sur l'œuf d'*Ascaris*," *C. R. Acad. Sc.*, 1932, **194**, 2336–8). Eggs of *Ascaris megalocephala* were submitted for increasing lengths of time to monochromatic X-rays, the energy being equivalent in each case. The radiations used were $\lambda = 2.28 \text{ \AA}$, 1.54 \AA , 1.1 \AA , and 0.7 \AA . The percentage mortality of the eggs was then determined. Below 1.54 \AA there is a falling off in lethal action which remains constant up to 0.7 \AA . G. M. F.

Acute Perivascular Myelinoclasia.—J. PICKFORD MARSDEN and E. WESTON HURST ("Acute Perivascular Myelinoclasia—'Acute Disseminated Encephalomyelitis' in Smallpox," *Brain*, 1932, **55**, 181–225, 1 pl.). The term "acute perivascular myelinoclasia" is one which has been applied by the authors to describe what is a single clinical and pathological entity, though it arises as a sequela to a heterogeneous group of factors. The term myelinoclasia shows that the constant and essential feature of the malady and the histological criterion of its existence is destruction of the myelin sheaths over a zone around the vessels, because damage to the axis-cylinders, though always present in some degree, is relatively less severe, and since inflammatory phenomena, such as perivascular infiltration with lymphocytes, vary greatly in intensity from case to case and may conceivably be excited by the irritating products of myelin degeneration. Acute perivascular myelinoclasia may occur independently of any recognized exciting factor, or it may follow certain exanthemata such as smallpox, vaccinia, measles, varicella, and probably rubella. It may also occur during the course of anti-rabic treatment. In all the known neurotropic virus diseases of man and animals, the primary attack is on the grey matter. G. M. F.

Arthropoda.

Arachnida.

Ecology of Hydracarina.—TOHRU UCHIDA ("Some Ecological Observations on Water Mites," *J. Fac. Sci. Hokkaido Univ. Sapporo, Japan*, Ser. VI, 1932, **1**, 143–165, 14 text-figs.). During his stay in 1930 at the Laboratoire d'Evolution des Êtres Organisés in Paris, the author made some ecological studies on water mites collected in the neighbourhood of the city. Reaction to sunlight, food, manner of coition, egg-laying, and postembryonal development are briefly dealt with. BM/HNDH

Hydracarina from France.—C. ANGELIER ("Contribution à l'étude de la Faune hydracarienne de la Marne," *Trav. Lab. d'Hydrobiol. Pisc. Univ. Grenoble*, 1931, **23**, 1–54, pls. I and II, 8 text-figs.). Records forty-seven more or less widely distributed species. The geographical and biological features of the area investigated are also stated. BM/HNDH

Protozoa.

Protozoan Cyst Wall.—C. A. KOFOID, E. MCNEIL, and M. J. KOPAC ("Chemical Nature of the Cyst Wall in Human Intestinal Protozoa," *Proc. Soc.*

Exp. Biol. & Med., 1931, 29, 100). The chemical nature of the wall was investigated in cysts of the following human intestinal protozoa: *Endamoeba histolytica*, *Endolimax nana*, "*Councilmania lafleuri*," "*C. dissimilis*," and *Giardia lamblia*. By appropriate tests it was found that the cyst wall was not of a carbohydrate, lipoidal, or chitinous nature. Its protein nature was demonstrated by the positive xanthoproteic and Millon's reactions. It is insoluble in the following strong acids: hydrochloric, nitric, sulphuric. It is also insoluble in alkali. The cyst wall appears to have the properties of keratins in the scleroprotein group. C. A. H.

Ciliates from Indian Cattle.—C. A. KOFOID and R. F. MACLENNAN ("Ciliates from *Bos indicus* Linn. II. A Revision of *Diplodinium* Schuberg," *Univ. Calif. Publ. Zool.*, 1932, 37, 53, 4 pls., 10 text-figs.). A revision of the genus *Diplodinium* Schuberg (fam. Ophryoscolecidae), based on material from *Bos indicus*, collected in India and Ceylon. The type species of the genus is *D. dentatum* (Stein) Schuberg. The generic classification in this paper is based on position and size of membranelle zones, number and form of skeletal plates, shape of the macronucleus, morphology of the oesophageal fibrils, and some other internal characters. *Diplodinium* is restricted and the following genera (some of which formerly constituted subgenera) are recognized: *Diplodinium* s.str., *Eodinium* gen.n., *Eremoplastron* gen.n., *Eudiplodinium* (Dogiel) emend., *Diploplastron* gen.n., *Metadinium* Awerinzew and Mutafova, *Polyplastron* (Dogiel) emend., *Elytroplastron* gen.n., *Ostracodinium* (Dogiel) emend., *Enoploplastron* gen.n. *Bos indicus* harbours twenty-one species of the above genera, including eleven new ones. A detailed description of these, with synonymics and habitats, is given. There are numerous illustrations. C. A. H.

Life-cycle of Cattle Piroplasm.—E. W. DENNIS ("The Life-cycle of *Babesia bigemina* (Smith and Kilbourne) of Texas Cattle-fever in the Tick *Margaropus annulatus* (Say), with Notes on the Embryology of *Margaropus*," *Univ. Calif. Publ. Zool.*, 1932, 36, 263, 6 pls., 1 text-fig.). Description of the life cycle of the piroplasm, *Babesia bigemina*, parasitic in cattle and causing Texas Fever in America. It was known that transmission was effected by *Margaropus annulatus*, but the development of the parasite in this tick has not been studied. *B. bigemina* undergoes an asexual phase of development in the vertebrate host where multiplication takes place in the erythrocytes by binary fission. When the blood of an infected animal is taken up by the tick the intracorpuseular parasites are set free in its gut, and are transformed into motile vermicular gametes. These are not sexually differentiated (isogametes). The gametes associate in pairs and fuse to form the zygote. The zygote becomes a motile ookinete which passes through the wall of the gut and penetrates into the adjacent reproductive organs. The ookinetes invade the ova of the tick where they round up and grow to form sporonts. The sporont secretes a cyst within which it divides to form naked sporoblasts. The sporoblasts form multinucleate sporokinetes which migrate and are distributed throughout the tissues of the developing tick. Those sporokinetes which come to occupy the salivary glands divide to form minute sporozoites. The sporozoites are inoculated into the blood of cattle with the saliva of the feeding tick larva. C. A. H.

Culture Medium for Intestinal Protozoa.—C. A. KOFOID and E. MCNEIL ("The Advantages of Locke's Blood Medium in the Culture of Parasitic Protozoa of the Digestive Tract," *Amer. J. Hyg.*, 1932, 15, 315). The authors advocate the use of the L.E.B. culture medium for *Endamoeba histolytica*, and other intestinal

protozoa, in preference to other media. This medium is made up as follows: slants made of 4 eggs + 50 c.c. Locke's solution and inspissated at 15 lbs. pressure for 30 minutes; Locke's solution, 500 c.c.; fresh defibrinated rabbit blood, 2.5 c.c. The following protozoa were grown successfully in this medium for long periods: *E. histolytica*, *Trichomonas*, *Chilomastix*, *Enteromonas*. C. A. H.

Coccidia of the Guinea-pig.—D. P. HENRY ("Coccidiosis of the Guinea-pig," *Univ. Calif. Pub. Zool.*, 1932, 37, 211, 4 pls.). A revision of the life-cycle and host-parasite relationships of the coccidium, *Eimeria caviae*, from the intestine of the guinea-pig. The endogenous part of the development lasts about twelve days, while the exogenous (sporogony) part takes from two to three days. In the guinea-pig diarrhoea and emaciation are the most constant clinical symptoms. The parasite causes intestinal hæmorrhages and sloughing of the mucous lining. C. A. H.

Investigation of Bird Coccidiosis.—E. E. TYZZER ("Criteria and Methods in the Investigation of Avian Coccidiosis," *Science*, 1932, 75, 324). An outline of the methods employed in the experimental investigation of fowl coccidiosis. The fowl harbours six species of *Eimeria*, and in order to study the reaction of the host to each species of parasite, or to determine which of these causes the pathological conditions observed, it is necessary to work with infection produced experimentally with single species. Pure strains can be isolated in various ways: from natural single species infection, by selecting material from a given region of the intestine, by collecting the earliest oocysts to appear in an experimental mixed infection, and by starting an infection from a single oocyst. In determining the species of *Eimeria* in fowl the following characters in addition to the dimensions of the oocysts are essential: the period required for development, the sporulation time, localization of infection, distribution of organisms in the intestinal epithelium, pathology of the infection, morphology of the developmental forms of the parasite, and the absence of cross immunity. Methods are described for preventing contamination of experimental chickens from infected ones. C. A. H.

Malarial Parasites of Birds.—P. F. RUSSEL ("Avian Malaria Studies. IV. *Hæmoproteus* and *Plasmodium* in Birds of Luzon, Philippine Islands. V. *Plasmodium capistrani* sp. nov., an Avian Malaria Parasite in the Philippines," *Philipp. J. Sci.*, 1932, 48, 263, 269, 2 pls., 1 text-fig.). The results of the examination of blood films from forty-six species of Philippine birds are reported. The parasites seen are referred to *Hæmoproteus columbæ*, *Plasmodium elongatum*, and *P. capistrani* sp.n. The latter was found in a quail, *Excalfactoria lineata*. It was inoculable to canaries and transmissible by *Culex quinquefasciatus* (*fatigans*). C. A. H.

Canine Leishmaniasis.—S. ADLER and O. THEODOR ("Investigations on Mediterranean Kala Azar. IV. Canine Visceral Leishmaniasis," *Proc. Roy. Soc.*, B, 1932, 110, 402, 2 pls.). Eleven out of 100 dogs examined in Malta were found to be naturally infected with Kala Azar. The most common symptoms of the disease in dogs are seborrhea and partial depilation. The skin condition is due to infiltration of macrophages around hair follicles. Infected macrophages are found in other parts of the skin, including normal dermis. Histologically the skin infection can be readily differentiated from that produced in Oriental Sore. Sand-flies (*Phlebotomus perniciosus*) were infected with *Leishmania* by feeding on the skin of three dogs, the infection rates being 62.5, 65.4, and 32 p.c. respectively. C. A. H.

Diagnostic Value of Size in Coccidia.—E. E. JONES ("Size as a Species Characteristic in Coccidia: Variation under Diverse Conditions of Infection," *Arch. Protistenk.*, 1932, **76**, 130). Description of experiments undertaken with the object to determine whether the difference in size between the oocysts of coccidia can serve as a criterion for the differentiation of species. Pure line strains of *Eimeria acervulina*, *E. maxima*, and *E. tenella*, all of which are parasitic in the domestic fowl, were used in this work. In the course of the experiments it was found that the size of the oocysts varied with the degree and duration of infection, but the breed of host and its age appear to have no influence upon the oocysts. The use of size as a criterion of species is valid only when a distribution curve, based on a large series of measurements, is symmetrical and continuous. Attempts were made to produce a race modified in size, by cross-breeding *E. acervulina* and *E. maxima* in mixed experimental infections. There was not, however, sufficient evidence that hybridization occurred, and the two parent strains are therefore regarded as true species. C. A. H.

Giardia of Sheep.—A. W. TURNER and D. MURNANE ("Giardia in Sheep in Victoria, Australia," *Austral. J. Exp. Biol. & Med. Sci.*, 1932, **10**, 53, 1 text-fig.). Description of *Giardia* found in large numbers in the abomasum of sheep in Australia. This parasite has not been reported since 1882 when Grassi described it from Italian sheep under the name *Megastoma entericum*. The sheep *Giardia* varies in length from 11.5–17 μ , in breadth from 7.5–11 μ . The ratio of breadth to length ranges from 0.47–0.82 μ , the average being 0.63 μ . C. A. H.

Fowl Coccidiosis.—E. E. TYZZER, H. THEILER, and E. E. JONES ("Coccidiosis in Gallinaceous Birds. II. A Comparative Study of Species of *Eimeria* of the Chicken," *Amer. J. Hyg.*, 1932, **15**, 319, 3 pls., 2 text-figs.). A comparative study of the species of *Eimeria* found in the domestic fowl, with special reference to the recently discovered *E. necatrix* and *E. praecox*. The number of species of *Eimeria* recognized at present is six. They are distinguished partly by their morphological characters, but mainly by their localization in the intestine of the host, the lesions produced, and their effect upon the host. *E. necatrix* produces a disease which is fatal. It attacks mainly the small intestine and caeca and is found intra- and sub-epithelially. *E. praecox* is confined to the epithelium of the small intestine and is practically innocuous. A detailed description is given of the course of development of these parasites and of the pathological-anatomical changes they produce in the host-tissues. C. A. H.

Foraminifera from the Gulf of Naples.—J. HOFKER ("Notizen ueber die Foraminiferen des Golfes von Neapel. III. Die Foraminiferen-fauna der Ammonatatura," *Publ. della Staz. Zool. di Napoli*, **12** (1), 1932, 61–144, 45 text-figs.). The "Ammonatatura" is a pocket or hole with a depth of 2–300 metres in the Bay of Naples, between Posillipo and the Island of Capri, noted for its abundant fauna, notably Cephalopoda. Its foraminiferal fauna bears great resemblance to that described by Lacroix from the coast off Monaco, including many Arenacea. Forty-six species in all are listed, including three new species and one new variety. Many of the species are dealt with at considerable length from a morphological standpoint. A. E.

Discammina, a New Genus.—E. LACROIX ("Discammina: nouveau genre méditerranéen de Foraminifères arénacés," *Bull. de l'Institut. Ocean. Monaco*, **600**, 1932, 1–4, 1 text-fig.). The genotype *Discammina fallax* is based upon a single specimen dredged off Cannes in a grey mud at the depth of 712 metres. The test

is arenaceous, consisting of a flattened, planospiral, unsegmented tube, the interior being labyrinthic in structure. In the absence of septa the genus shows affinity to *Ammodiscus*, though the labyrinthic interior suggests a relationship with *Cyclammina*. A. E.

Australian Shallow-Water Foraminifera.—W. J. PARR ("Victorian and South Australian Shallow-Water Foraminifera," Part 2, *Proc. Roy. Soc. Victoria*, 44 (N.S.), 2, 1932, 218–234, pls. 21–2, 1 text-fig.). Seven new species and one new variety are figured and described, several being of particular interest, as they have long been familiar objects in Australian gatherings but have hitherto remained undescribed. Many of the species recorded mark extensions of the range previously known. This is the concluding part of a paper which should prove of great value, as it is many years since any one has devoted attention to Australian recent foraminifera. The area is so large and so rich in species that it is to be hoped the author will continue his researches in a fresh series. The illustrations are excellent, though somewhat too delicate for reproduction. A. E.

Tropical Pacific Foraminifera.—J. A. CUSHMAN ("The Foraminifera of the Tropical Pacific Collections of the 'Albatross,' 1899–1900. Part 1, *Astrorhizidae* to *Trochamminidae*," *U.S. Nat. Mus. Bull.* 161, 1932, 1–88, 17 pls., map). The track of the "Albatross," as shown on the map, runs almost due south from San Francisco through deep water to the Marquesas Islands, thence to the Paumotu Archipelago in 20° S., turning westwards roughly along that parallel to the Tonga Islands, thence north and west through the Marshall and Caroline groups of islands. The majority of the stations therefore lie in deep water between the parallels of 20° N. and 20° S. respectively, but the material has been supplemented by shallow-water gatherings made in the same area. A general survey shows that while the deep-water species have a wide distribution, various groups of islands have locally developed species that are strictly limited in their distribution. Numerous species occur which are definitely associated with other regions—the West Indies, Mediterranean, and Red Sea. A few are closely related to species recorded from the Miocene and Pliocene of Southern Europe. Twelve new species and seven new varieties are described. The plates are admirable. A. E.

Australasian Fossils.—F. CHAPMAN and IRENE CRESPIN ("Rare Foraminifera from Deep Borings—Part III," *Proc. Roy. Soc. Victoria*, 1932, 44, pt. i, n.s., 92–9, pls. xi–xiii). Two new species of *Lepidocyclina*, *L. hamiltonensis*, and *L. houchini* are described from the boring at Hamilton, Victoria. From the same locality *Spiroclypeus margaritatus* (Schlumberger) has been recorded, the first definite record in Australia. A few other species and varieties of the larger forms are recorded from various borings and outcrops in Victoria, Papua, and New Guinea. The illustrations from photographs are good. A. E.

North American Orbitolinæ.—A. SILVESTRI ("Revisione di Orbitoline Nordamericane e nuova località di Chapmanine," *Mem. Pont. Acc. Sci. Nuovi Lincei*, 1932, ser. 2, 16, 371–94, 2 pls.). After a study of topotypes of the Central Texas forms recorded by authors under the names *Orbitolina texana* (Roemer), *O. whitneyi* Carsey and *O. walnutensis* Carsey, the author is convinced that the first two are *Orbitolinæ* in the true sense, and should properly be recorded as *Orbitolina concava* (Lamarck) var. *texana* (Roemer). The third form is a *Dictyoconus* and should be known as *Dictyoconus aegyptiensis* (Chapman) var. *walnutensis* (Carsey). A. E.

Ultramicroscopic Viruses.

Cultivation of the Virus Myxomatosum.—H. PLOTZ ("Culture du virus myxomatosum (Sanarelli) en présence de cellules vivantes," *C. R. Soc. Biol.*, 1932, 109, 1327–29). The successful cultivation of two strains of virus myxomatosum through twenty generations is reported. The medium consisted of rabbit serum (2 c.c.) and Tyrode (6 c.c.) to which were added mononuclear leucocytes obtained from the rabbit's pleural cavity. G. M. F.

A New Virus Disease of Parrots.—T. M. RIVERS and F. F. SCHWENTKER ("A Virus Disease of Parrots and Parakeets differing from Psittacosis," *J. Exp. Med.*, 1932, 55, 911–24, 3 pls.). In the course of investigations on the pathology of parrots in Brazil, Pacheco, Bier, and Meyer (*C. R. Soc. Biol.*, 1930, 105, 109) obtained evidence of a filterable virus pathogenic for parrots. Investigations now recorded confirm and extend these observations. The symptoms in parrots are very similar to those produced by the psittacosis virus but the parrot virus is not pathogenic for man, monkeys, rabbits, guinea-pigs, and mice. In addition to parrots one- or two-day-old chickens were found to be partially susceptible, while chick embryos are suitable hosts for the serial passage of the virus. Areas of focal necrosis are present in the liver and many of the liver cells contain acidophilic intranuclear inclusions. G. M. F.

Researches on the Ætiology of Post-vaccinal Encephalitis.—C. KLING, E. WASSÉN, and J. FAHRÆUS ("Récherches sur l'étiologie de l'encéphalite post-vaccinale," *C. R. Soc. Biol.*, 1932, 109, 1337–40).

Morphology of the Parasite Present in the Central Nervous System of Subjects Suffering from Post-vaccinal Encephalitis.—("Morphologie du parasite siégeant dans le névraxe des sujets atteints d'encéphalite post-vaccinale," *Ibid.*, 1340–44, 3 text-figs.) In the brains of five cases of post-vaccinal encephalitis the authors claim to have demonstrated various forms of a parasite which they believe to be the cause of the disease, though up to the present attempts to cultivate it have failed. The various forms comprise: (1) Round, ovoid, elongated or pear-shaped bodies, with rounded extremities, from $0.8-1.2\mu$ in length and from $0.5-0.6\mu$ in breadth. (2) Round or oval bodies with a thin layer of cytoplasm surrounding one or more vacuoles. One or two chromatic granules situated near one or other pole are generally present. (3) More voluminous though rarer forms, round or oval, $2-3\mu$ in length and about 1μ in breadth, containing three to six chromatic granulations and one or more vacuoles. (4) A filamentous form attached to one end of the parasite. The organisms are coloured by Giemsa's method. The parasites are found alone, in couples, in small masses, and sometimes in chains like streptococci. (5) Tiny ovoid or rod-shaped corpuscles $0.2-0.4\mu$ in length and 0.1μ in breadth, the protoplasm containing one or two chromatic particles situated either in the middle or at the poles. G. M. F.

The Virus of Psittacosis.—S. P. BEDSON ("The Nature of the Elementary Bodies in Psittacosis," *Brit. J. Exp. Path.*, 1932, 13, 65–72, 4 text-figs.). Psittacosis virus can be thrown down almost completely by centrifugation at a speed of about 5000 revolutions per minute. The virus can be freed from extraneous matter by fractional centrifugation and washing. The only particulate matter in a twice-washed deposit consists of minute bodies in every respect similar to those seen in preparations made from virulent material. The washed bodies are agglutinated specifically by an anti-psittacosis serum and fix complement in its presence, but

do not react in either way with an anti-mouse spleen serum. These results warrant the conclusion that the minute bodies which can be seen in sections or smears of the spleen are the actual virus.

G. M. F.

Louping-ill in the Mouse and Monkey.—E. W. HURST ("The Transmission of 'Louping-ill' to Mouse and the Monkey: Histology of the Experimental Disease," *J. Comp. Path. & Therap.*, 1931, 44, 231-45, 1 pl., 8 text-figs.). The disease known as "louping-ill" is transmissible to mice and rhesus monkeys. In the mouse, among rather variable symptoms, paralysis and incoordination take a prominent place. The lesions are of the nature of a diffuse encephalomyelitis with mild meningeal involvement. In monkeys a progressive ataxia of cerebellar type was the dominant clinical feature, while histologically a more or less diffuse encephalomyelitis was accompanied by massive destruction of the Purkinje cells of the cerebellum. The analogy to the destruction of the anterior horn cells in poliomyelitis is drawn. In the mouse, but not in the monkey, intracytoplasmic bodies, believed to be of the nature of inclusion bodies, are found in the nerve cells. They are most readily demonstrated after fixation in formol corrosive and subsequent staining with eosin, methylene blue.

G. M. F.

A Virus Disease of Mice.—G. M. FINDLAY ("Intranuclear Bodies in the Liver-cells of Mice," *Brit. J. Exp. Path.*, 1932, 13, 223-9, 1 pl.). Intranuclear bodies have been found in the liver-cells of a strain of apparently normal mice. Evidence is brought forward to suggest that they are caused by a filterable virus of low pathogenicity. In their early stages the acidophilic intranuclear bodies closely resemble hypertrophic nucleoli.

G. M. F.

Intranuclear Bodies in Gliomas and Hodgkin's Disease.—D. S. RUSSELL ("The Occurrence and Distribution of Intranuclear 'Inclusion Bodies' in Gliomas," *J. Path. & Bact.*, 1932, 35, 625-34, 2 pls.). Intranuclear inclusion bodies have been found in 33 p.c. of a series of 192 gliomas. They were chiefly present in examples of spongioblastoma multiforme, 61 p.c. of which showed this change. Similar bodies have been found in the liver in a relatively large proportion of cases of Hodgkin's lymphogranuloma and in a small proportion of deaths from various causes. They were formed most probably by alteration of nucleoli, but origin in the nucleoplasm could not be excluded. No association was found with a typical development of cells nor with ordinary degenerations of cells and their nuclei. The bodies resemble the intranuclear inclusions described as characteristic of certain virus infections.

G. M. F.

Intranuclear Inclusions in the Lungs.—H. A. MCCORDOCK ("Intranuclear Inclusions in Pertussis," *Proc. Soc. Exp. Biol. & Med.*, 1932, 29, 1288-91, 1 pl.). In the lungs of twelve out of thirty-five cases of whooping cough there were present intranuclear inclusions in the cells lining the alveoli as well as in the bronchial epithelium. In a few cases they were found in liver cells about areas of necrosis and under the same circumstances in cells of the adrenal glands as well as in the mucous glands of the smaller bronchi. The inclusions are acidophilic and a clear zone separates the inclusion from the nuclear membrane to which small fragments of chromatin are often found adhering. In two out of ninety control cases similar inclusions were found in the lungs. The fact that intranuclear inclusions were present in more than a third of the total number of cases of whooping cough is regarded by the authors as suggesting the possibility of a virus infection in this disease.

G. M. F.

The Cultivation of Typhus Fever Rickettsia.—C. NIGG and K. LAND-STEINER ("Note on the Cultivation of the Typhus Fever Rickettsia," *Proc. Soc. Exp. Biol. & Med.*, 1932, **29**, 1291). Good growth of typhus rickettsia has now been obtained with guinea-pig testicle and kidney in addition to tunica and peritoneum. Multiplication also occurred when guinea-pig brain, heart, adrenal, lung, spleen, and embryo were used in the serum Tyrode medium. Phenol red was added to the Tyrode medium in order to follow changes in reaction. By reducing the amount of tissue in the medium, it was possible to retard the change in reaction, a circumstance perhaps significant in obtaining positive results. G. M. F.

The Presence of Rickettsia in Rats from Men-of-War at Toulon.—MARCANDIER and R. PIROT ("Présence d'un virus, voisin de celui du typhus exanthématique, chez les rats des navires de guerre à Toulon," *C. R. Acad. Sci.*, 1932, **194**, 399-401). The brains of rats caught on board French naval vessels at Toulon when inoculated into guinea-pigs and monkeys produced symptoms of typhus with, in the case of the guinea-pigs, inflammatory lesions of the tunica vaginalis. G. M. F.

Negri Bodies in Rabbits' Brains produced by Fixed Virus.—S. NICOLAU and L. KOPCOWSKA ("Zone élective pour les corps de Negri chez les lapins morts de rage expérimentale à virus fixe," *C. R. Acad. Sci.*, 1932, **194**, 1865-7, 4 text-figs.). By using the slow method of Giemsa staining it is possible to demonstrate in the cells of the horn of Ammon a few Negri bodies even in the brains of rabbits dying after inoculation with fixed rabies virus: In the cells of the basal optic nuclei, however, Negri bodies are readily demonstrable. G. M. F.

Intranuclear Inclusions in Poliomyelitis.—E. W. HURST ("The Occurrence of Intranuclear Inclusions in the Nerve Cells in Poliomyelitis," *J. Path. & Bact.*, **34**, 331-3, 1 pl.). The description by W. P. Covell (*Proc. Soc. Exp. Biol. & Med.*, 1930, **27**, 927) of intranuclear inclusions in anterior poliomyelitis is here confirmed. They occur always in damaged cells both in monkeys and in man. The most suitable fixative is sublimate-formol or Zenker formol with subsequent staining by Mallory's phloxine-methylene blue method. G. M. F.

BOTANY.

(Under the direction of A. B. RENDLE, D.Sc., F.R.S.)

GENERAL.

Cytology.

Meiotic Abnormalities in *Lychnis*.—H. SOKOLOWA ("Some Irregularities in the Reduction Division in *Lychnis chalconica*," *Cytologia*, 1931, 2, 302-17). The haploid number of chromosomes in *Lychnis chalconica* is 12. The development of the ovule and female gametophyte are described. In eight of the ten heterotypic metaphases observed in the megaspore mother-cells an extruded geminus is seen lying in the cytoplasm. The extended chromosomes remain in the cytoplasm of one of the daughter-cells: their further fate was not traced. Probably they degenerate with the upper megaspores, as they were never seen in the cytoplasm of the functional lower megaspore. Variations occur in megaspore number, and in the number of nuclei in the mature embryo-sacs. In microsporogenesis, out of 121 heterotypic metaphases studied sixty-seven showed the extruded bivalent outside the spindle. At tetrad formation the cast-off bivalent lies in the cytoplasm of one of the young microspores and does not form a micronucleus. Chromosome counts were not obtained from the pollen grains, but the appearance of the pollen indicates that grains with 11 chromosomes have normal viability. Fertilization and the development of the embryo are described. The percentage of germination is low, about 30 p.c. Somatic counts were obtained from eighty seedlings, all of which were normal diploids with 24 chromosomes. The author concludes that 11 chromosomal gametes are functional, and that embryos with aberrant chromosome numbers are capable of development but perish during the early stages of germination. The author enumerates six lines along which his investigations are being continued. J. L.

Chromosome Numbers in *Hypericum*.—C. S. HOAR and E. J. HAERTL ("Meiosis in the Genus *Hypericum*," *Bot. Gaz.*, 1932, 93, 197-204). An account is given of the habitat, morphology, meiotic behaviour and chromosome counts of several species of *Hypericum* from the north-eastern United States of America. In every form studied the chromosomes pair normally at diakinesis. *H. perforatum*, $n = 16$ or 18, is probably a tetraploid. Its meiotic behaviour and abundant sterile pollen indicate that it may be a natural hybrid. *H. adpressum*, *H. adpressum* var. *spongiosum*, *H. lobocarpum*, *H. aureum*, *H. nudiflorum*, *H. ellipticum*, and *H. Kalmianum* have the haploid number 9 and regular meiotic behaviour. The same haploid count ($n = 9$) and regular behaviour are found in two known hybrids, *H. Arnoldianum* and *H. Dawsonianum*. In the following species $n = 8$: *H. muticum*, *H. boreale*, *H. majus*, and *H. canadense*. Two species are distinct in many ways from all others studied: *H. gentianoides* in which $n = 12$, and *H. virginianum* with $n = 19$. It is possible that these two should be removed from the genus *Hypericum* and classified as by BRITTON and BROWN (1897) as species of *Triadenum*. J. L.

Chromosome Counts in the Malvaceæ.—E. VON KESSELER ("Observations on Chromosome Number in *Althæa rosea*, *Callirhoë involucrata*, and *Hibiscus coccineus*," *Amer. J. Bot.*, 1932, 19, 128-30). The haploid chromosome number of both single and double flowered forms of *Althæa rosea* is 21. Counts of the somatic chromosomes in root-tips vary from 38-50, even in material from the same individual. This variability is explained by the early splitting of the chromosomes preparatory to anaphase separation. The haploid number for *Callirhoë involucrata* is 12. No perinuclear zone occurs in this species. Somatic counts only were attempted for *Hibiscus coccineus* and the number found to range from 37-50 in root-tips. J. L.

Chromosomes of Shepherdia.—D. C. COOPER ("The Chromosomes of *Shepherdia canadensis*," *Amer. J. Bot.*, 1932, 19, 429-31). Meiosis in the pollen mother-cells of *Shepherdia canadensis* is described. The haploid number of chromosomes is 11. At diakinesis the bivalents vary considerably in size and shape. There is no evidence at any stage of a heteromorphic pair of chromosomes. Somatic cells were studied and the diploid chromosome number found to be 22. J. L.

Chromosome Numbers in Cucurbitaceæ.—J. W. MCKAY ("Chromosome Studies in the Cucurbitaceæ," *Univ. Calif. Pub. Bot.*, 1931, 16, 339-50). Chromosome counts were obtained from root-tips of twenty-two species of cucurbits. The range of diploid numbers found is 22, 24, 26, 32, and 40. The study of chromosome number and morphology is of value in determining the taxonomic relationship of *Benincasa cerifera* which undoubtedly belongs to the *Cucurbita* group. From five species of the genus *Luffa* evidence is obtained that the haploid number is 13 and not 11 as previously reported for *L. cylindrica*. The author is of opinion that considerable confusion exists in the nomenclature of the genus *Luffa*. It is suggested that the present-day species of *Cucurbita* may have arisen by hybridization of existing or pre-existing forms followed by amphidiploidy. A table is given which summarizes the chromosome numbers reported by all investigators up to the present time. J. L.

Chromosomal Types in Datura.—A. F. BLAKESLEE ("Extra Chromosomes, A Source of Variations in the Jimson Weed," *Smithsonian Report*, 1930, Publication 3096, 431-50). The chromosomal types in the Jimson Weed (*Datura Stramonium*) are described and explained with the aid of photographs of the different types and diagrams representing the chromosomal sets. The types dealt with are haploids, diploids, triploids, and tetraploids; primary, secondary, and tertiary ($2n + 1$) types; double ($2n + 1 + 1$) types and compensating types. The number of forms known in *Datura* fall into thirty-two distinct classes based on chromosomal constitution. A table is given showing the chromosomal type, chromosomal formula, number of forms at present identified, and number of theoretically possible forms of these different classes. The origin of the chromosomal types is briefly discussed. By means of extra chromosomes and parts of chromosomes it has been found possible to secure a wide range of variations in *Datura* affecting the structure and physiology of all parts of the plant. The author states his belief that in the future extra chromosomes will be consciously utilized as a source of desirable variations in plants of economic importance. J. L.

Chromosome Behaviour in Petunia.—W. C. STEERE ("Chromosome Behaviour in Triploid *Petunia* Hybrids," *Amer. J. Bot.*, 1932, 19, 340-57). The

basic haploid chromosome number in *Petunia* is 7. The author confirms previous reports that the giant-flowered races of *P. hybrida* are tetraploids with 28 somatic chromosomes. Mitosis and meiosis were examined in the pure diploid species *P. axillaris* and found to be perfectly normal. Crosses were made between *P. axillaris* ($n = 7$) which has white flowers and yellow pollen and a tetraploid race of *P. hybrida* ($n = 14$) with dark-coloured flowers and blue pollen. Large progenies were obtained from diploid ♀ × tetraploid ♂ and many plants examined proved to be normal diploids. All had combined characters from both parents. When tetraploid ♀ was crossed with diploid ♂ only sixteen plants appeared and all proved to be triploids with 21 somatic chromosomes. Most of the triploids were intermediate between the parents in size and habit. Mitosis is perfectly normal. Meiosis is described from diakinesis onwards, and is of remarkable regularity. At heterotypic metaphase there is normally complete association of the chromosomes into seven trivalents. Rarely the trivalents dissociate into a bivalent and univalent, or three univalents, and lagging chromosomes result. The most frequent segregation of chromosomes is 10 and 11 to the daughter nuclei. "Lagging" leads to the production of a considerable amount of sterile pollen. The author concludes with a discussion on triploidy and notes that usually triploids have arisen from the union of a diploid egg with a haploid sperm. J. L.

Constant Amphidiploid Hybrid in Brassica.—H. N. FRANDSEN and O. WINGE ("Brassica napocampestris, a New Constant Amphidiploid Species Hybrid," *Hereditas*, 1932, 16, 212-18). Artificial crossings were made between swede (*Brassica Napus* L. var. *sativa-rapifera*) and turnip (*B. campestris* L. var. *sativa-rapifera*) and a small number of F_1 plants obtained. The F_1 plants were mainly intermediate in character and only slightly fertile on self-pollination. F_1 plant no. 103, however, showed far greater fertility than the rest and produced an F_2 family of 286 plants. This family was characterized by great constancy of type, whereas other F_2 families showed pronounced segregation into different types. The progeny of the F_1 plant no. 103 has been examined cytologically and counts from root-tips show 56 chromosomes. The parents, *B. Napus* and *B. campestris*, have 36 and 20 respectively. The constancy of the F_2 generation is regarded as obviously due to a somatic doubling in the F_1 plant, the doubling probably having taken place at the first cell-division in the zygote. *B. napocampestris* is thus a new instance of a constant hybrid or a new species originated by species crossing and a subsequent total doubling of the somatic chromosomes in F_1 . J. L.

Fixation Images and Chromosome Morphology in Pisum.—A. G. MARSHAK ("The Morphology of the Chromosomes of *Pisum sativum*," *Cytologia*, 1931, 2, 318-39). A brief review is given of cytological investigations on chromosome morphology in *Pisum sativum*. In the present work mitosis and meiosis were studied in root-tips and buds of various strains which showed no cytological differences. Different methods of fixation for root-tips (paraffin method) and pollen-mother-cell smears are described and discussed, and the different fixation images of nucleoli and chromosomes described in detail and figured. After formalin fixation the period of washing in running water influences the fixation image obtained. Formalin appears to make some of the nucleolar material and the matrix substance of somatic and meiotic chromosomes soluble in water, or to fail to render them insoluble as do the chromic-fatty acid-formalin fixatives. Alcohol appears to dissolve the meiotic chromosome matrix or to render it achromatic. An intimate relationship is established between the nucleolar material and the

matrix substance of somatic chromosomes, and the possible identity of these substances noted. The morphological features of the somatic and meiotic chromosomes are described. Each of the seven members of the chromosome complement can be identified by its relative length, position of the primary constriction, presence or absence and position of secondary constrictions. The chromonemata of the first meiotic metaphase and the chromosomes of later stages show the same individual characteristics as the somatic chromosomes. J. L.

Partial Sterility and Chromosome Association in Hybrids of *Pisum*.—C. PELLEW and E. R. SANSOME ("Genetical and Cytological Studies on the Relations between Asiatic and European varieties of *Pisum sativum*. I. Partial Sterility in Hybrids of a Thibetan and a European Variety, PELLEW. II. Chromosome Association in *Pisum*, SANSOME," *J. Gen.*, 1931, 25, 25-54). A Thibetan variety of *Pisum sativum* was crossed with var. Duke of Albany and with one exception the fertility of the hybrids was complete. The exceptional case occurred when a particular plant of the Thibetan variety was used. Regular gametic sterility then appeared, resulting in the failure of about half the male and female gametes. The semi-sterility is associated with the formation of a ring of four chromosomes in the reduction divisions. This ring of four chromosomes and five pairs are present in the semi-sterile plants, whereas fertile sister plants have the seven pairs normal for *Pisum*. The association of four is shown to depend upon the formation of chiasmata between homologous segments. In about half the cases examined non-disjunction occurs in the ring, two adjacent chromosomes passing to each pole. This possibly gives rise to non-viable gametes through genetic unbalance. J. L.

Haploid Plant of Rice.—T. MORINAGA and E. FUKUSHIMA ("Preliminary Report on the Haploid Plant of Rice, *Oryza sativa* L.," *Proc. Imp. Acad.*, 1931, 7, 383-4). All the previously investigated varieties of rice have 12 as the haploid chromosome number. The cross *Dekiyama* × *Bunketu-tô* (a dwarf variety) produced an F₁ of thirteen plants amongst which one proved to be haploid. The haploid plant resembled the female parent but was much reduced in size, and was highly sterile. Chromosome counts were obtained from root-tips, and the somatic number found to be 12. J. L.

Chromosomes of *Nothoscordum*.—J. M. BEAL ("Chromosomes of *Nothoscordum bivalve*," *Bot. Gaz.*, 1932, 93, 105-6). In this preliminary note on the chromosomes of *Nothoscordum bivalve* the author states that the haploid chromosome number is 9, the somatic number in root-tips 18. Median or sub-median constrictions are clearly evident. At diakinesis and heterotypic metaphase two ordinary bivalents and seven "rings" or "double pairs" of what first appeared to be four univalents joined end to end are frequently seen. These compound groups are really bivalents, the two members of which are deeply constricted. The median or submedian constrictions can be followed through all the later meiotic stages. A detailed account is in preparation. J. L.

Chromosome Morphology and Meiosis in *Kniphofia*.—J. M. WEBBER ("Chromosome Morphology and Meiotic Behaviour in Typical and Variant Forms of *Kniphofia aloides*," *Amer. J. Bot.*, 1932, 19, 411-22). The somatic divisions of *Kniphofia aloides* show 12 chromosomes which can be separated into five types on the basis of size differences, position of constrictions, and presence of satellites. Meiosis is described from diakinesis onwards. The five types of chromosomes can be distinguished during meiosis by their shape and modes of pairing. The morpho-

logical characteristics of the 6 haploid chromosomes are clearly seen during the divisions within the male gametophyte. Two variant forms of *K. aloides* were examined and found to be chromosomal variants. One was more vigorous in habit than the average and was a trisomic with five bivalents and one trivalent at diakinesis. The external characters of the other variant were slightly dwarfed and the plant found to contain one extra large chromosome. The extra large chromosome is considered to be a normal homologue with a duplicated section. Meiosis in the trisomic leads to the production of four types of gamete: n , $n + a$ fragment, $n + 1$, and $2n + 1$. Meiosis in the dwarfed variant is normal. The chromosomal variants probably originated from the typical form or a closely related form by methods involving polyploidy or non-disjunction and fragmentation.

J. L.

Chromosome Pairing in *Yucca*.—J. O'MARA ("Chromosome Pairing in *Yucca flaccida*," *Cytologia*, 1931, 3, 66-76). Microsporogenesis was studied in *Yucca flaccida*. Thirty chromosomes are present on the metaphase plate, 5 large "megachromosomes" and 25 very small "microchromosomes." The large chromosomes are approximately 3.0μ long and the microchromosomes 0.4μ . Chiasma frequency is 3.0 in the large chromosomes, chiasma formation being perfectly random. If chiasmata alone hold the chromosomes together, the small chromosomes should, on this basis, be frequently unpaired. In no case, however, were any chromosomes found unpaired, nor any abnormalities seen in meiosis. A hypothesis is put forward to account for the pairing of small chromosomes. The cytological and genetical evidence indicate that Darlington's theory of chromosome pairing at meiosis is invalid. This work on *Yucca* points to the conclusion that chiasmata increase the degree of association of homologous chromosomes at meiosis but are not necessary for chromosome pairing and normal meiosis.

J. L.

Chromosome Number in the Pineapple.—J. L. COLLINS and K. R. KERNS ("Genetic Studies of the Pineapple. I. A Preliminary Report upon the Chromosome Number and Meiosis in Seven Pineapple Varieties (*Ananas sativus* Lindl.) and in *Bromelia pinguin* L.," *J. Heredity*, 1931, 22, 139-42). Seven varieties of *Ananas sativus* were studied and showed the haploid chromosome number to be 25. Counts were made from root-tips of three of these varieties and showed 50 somatic chromosomes. Only rarely were indications of irregularities seen at meiosis. The mature pollen-grains frequently showed size differences. A cross of two varieties ($n = 25$) produced six triploid plants with 75 chromosomes in an F_1 of 8000 plants. Preliminary observations on meiosis reveal irregularities in the triploids. From their appearance the triploids are considered to contain 50 maternal and 25 paternal chromosomes. Heilborn's investigation on the pineapple (1921) is discussed and the conclusion reached that his plant with 75 somatic chromosomes was also a triploid. Forty-eight haploid chromosomes are found in *Bromelia pinguin*, a species closely related to the pineapple.

J. L.

Chromosome Numbers in Annual and Perennial Sorghums.—A. E. LONGLEY ("Chromosomes in Grass Sorghums," *J. Agric. Research*, 1932, 44, 317-21). The perennial Johnson grass (*Sorghum halepense*) has 20 haploid chromosomes. The very similar annual Sudan grass (*S. sudanense*) and six other annual species studied have 10 haploid chromosomes. *S. versicolor*, a short-lived annual, was found to have 5 haploid chromosomes, and the reduced number for the annual *S. purpureo-sericeum* was exceptional in being 20. A brief resumé is

given of previous investigations on chromosome numbers in *Sorghum* and related genera. The association between low chromosome number and the annual habit finds but few exceptions in the closer relatives that have been examined cytologically. If the chromosomes of the perennial sorghums represent a duplication of the chromosome set in the annual forms, it indicates that the perennial plants have been derived from annual ancestors with 10 chromosomes. J. L.

Cytology of Brassica Hybrids.—T. MORINAGA ("Interspecific Hybridization in *Brassica*. IV. The Cytology of F_1 Hybrids of *B. carinata* and some other Species with 10 Chromosomes," *Cytologia*, 1931, 3, 77–83). The author confirms the report of Karpechenko that the haploid number of chromosomes in the Abyssinian mustard, *Brassica carinata*, is 17. The F_1 hybrids used in this investigation were *B. chinensis* L. \times *B. carinata* Braun and *B. carinata* Braun \times *B. Rapa* L. The somatic chromosome number in the root-tips of both hybrids was 27. The features seen in microsporogenesis were the same in both hybrids. At heterotypic division the number of bivalents varies from 1 to 9. Many univalents divide at heterotypic anaphase and their halves are distributed at random to either pole on the homotypic spindle. Lagging chromosomes often caused the formation of microsporocytes; diads and triads were also observed. J. L.

Mitosis and Meiosis in Capsicum.—P. D. DIXIT ("A Cytological Study of *Capsicum annum*," *Indian J. Agric. Sci.*, 1931, 1, 419–33). A detailed account is given of the mitotic divisions in the root-tips of *Capsicum annum*. The diploid number of chromosomes is 24. There is evidence that the nucleolus is intimately connected with the formation of the chromosomes. The author regards it as a storehouse of chromatic material which flows into the spireme during prophase. The nucleolus increases in size at prophase. This increase is thought to be due to the inflowing of the clear fluid in the space formerly surrounding the nucleolus, while the chromatic material is flowing out. Nucleolar material possibly gives rise to the spindle fibres. Meiosis was studied in smear preparations. A satisfactory modification of the hæmatoxylin-balsam-smear technique is fully described. The haploid chromosome number is found to be 12, and not 6 as reported by Kostoff (1926). J. L.

Cytology of the Sugar Beet.—CZESŁAWA PRYWER ("Cytological Studies in the Sugar Beet," *Acta Soc. Bot. Polonica*, 1931, 8, 19–46. Polish with English Summary). Ten plants of the sugar beet *Beta vulgaris* var. *saccharifera* were investigated cytologically and the somatic chromosome number found to be 18. Rarely were 19 chromosomes found due to fragmentation. Four morphologically distinct types of chromosome are present in the somatic set: (1) bi-armed chromosomes with approximately equal arms; (2) bi-armed chromosomes with arms of considerably different lengths; (3) bi-armed chromosomes in the form of Γ , S or 3 with median attachment constriction and probably a subterminal secondary constriction; (4) chromosomes in the form of C or nearly straight (rod-shaped), the attachment constriction being difficult to discern. The shape of the chromosomes of each type shows great variability and the identification of homologous chromosomes is often very difficult. Abnormalities are found in the meiotic divisions. Satellites attached to the chromosomes directly or by a fine thread are seen at diakinesis. These are probably products of fragmentation; in later stages they may remain in the cytoplasm. The chromosome pairs may be irregularly arranged on the heterotypic spindle. At anaphase and telophase lagging chromosomes or their fragments might remain in the cytoplasm and later produce microcytes. Two irregularities which might give rise to diploid gametes were observed: (1) the

formation of a unipolar spindle at heterotypic metaphase, thus causing suppression of the first division; (2) fusion of the two homotypic spindles. The author considers that the meiotic abnormalities observed in *Beta vulgaris* are caused by considerable changes in temperature during the fixation of the material. J. L.

Meiosis in Rye.—H. C. GURNEY ("The Cytology of Rye," *Australian J. Experimental Biology and Medical Sci.*, 1931, 8, 241-54). Microsporogenesis was studied in a 7-chromosome race of rye (*Secale cereale*), and is described in detail. As the synaptic knot loosens a continuous spireme is formed which gives rise to the bivalent chromosomes by looping and twisting. These events strongly support a telosynaptic interpretation of the mode of chromosome pairing. A second contraction stage follows; the contraction is always associated with the nucleolus and provides evidence that the nucleolus acts as a storage of chromatin. At heterotypic metaphase the 7 bivalent chromosomes can be distinguished by their characteristic sizes, shapes, and spindle-fibre attachments. These characteristics do not persist through the homotypic division. A continuous spireme is formed at interphase: this breaks transversely into seven lengths at the beginning of the homotypic division. At homotypic telophase a continuous spireme is formed, from which is produced the reticulum of the resting nucleus. With telosynapsis the necessity of some regular method of forming the spireme from the chromosome chromonemas is pointed out, and a method is suggested. J. L.

Analysis of Chromosome Pairing in Triticum Hybrids.—C. D. DARLINGTON ("The Analysis of Chromosome Pairing in *Triticum* Hybrids," *Cytologia*, 1931, 3, 21-25). From studies of chiasma frequency and bivalent form in *Triticum* species and hybrids the author points out that the following features must be taken into consideration in arguing relationship of chromosomes from their behaviour in hybrids: (1) comparative chiasma frequency of parents and hybrids; (2) the occurrence of differential affinity amongst the homologous chromosomes in a polyploid and its possible modification by polarization; and (3) the possible lack of correlation between structural and non-structural changes in the chromosomes. J. L.

Chromosome Ring Formation in Rhæo.—KARL SAX ("Chromosome Ring Formation in *Rhæo discolor*," *Cytologia*, 1931, 3, 36-53). *Rhæo discolor* has 12 somatic chromosomes differing considerably in length and spindle fibre attachment which form either a ring or one to three chains at meiosis. In about half of the reduction divisions alternate chromosomes pass to opposite poles, but various types of non-disjunction frequently occur and are a cause of the high percentage (80-90 p.c.) of pollen sterility. The sequence of 8 of the 12 meiotic chromosomes in the ring is as follows: 2 heterobrachial chromosomes are followed by a long isobrachial chromosome which is attached to another "pair" of heterobrachial chromosomes, followed by a short isobrachial chromosome and a less distinctly heterobrachial "pair." These chromosomes are always found in the same order in the ring. The heterobrachial chromosomes are always attached at their proximal ends. It is suggested that segmental interchange may be caused by interlocking of non-homologous bivalent chromosomes during synapsis, with subsequent breaks at the point of contact and reunion of non-homologous segments. The origin of balanced lethals in species which breed true for chromosome rings is attributed to occasional deficiencies occurring with segmental interchange. *Rhæo* plants which were subjected to low temperature show complete lack of chromosome pairing. The 12 univalent chromosomes divide equationally at both

meiotic divisions resulting in microspores with the complete number of somatic chromosomes. J. L.

Gametogenesis in *Bromus*.—P. BECK and J. S. HORTON ("Microsporogenesis and Embryogeny in Certain Species of *Bromus*," *Bot. Gaz.*, 1932, 93, 42-54). The species studied are *Bromus villosus* Forsk., *B. marginatus* Nees, and *B. rubens* L. The basal haploid number in the Gramineæ is 7. *B. villosus* is variable between octoploid and decaploid, the counts varying from 28-35 at heterotypic metaphase. *B. marginatus* is octoploid with 28 bivalents and *B. rubens* tetraploid with 14 bivalents at heterotypic metaphase and diakinesis respectively. Lagging bivalents occur in *B. marginatus* and *B. villosus*: in the latter species the homotypic division is irregular. In all three species varying types of chromatin extrusion are found, also polycary and sterile pollen. Polyploidy and meiotic irregularities indicate that these species may be hybrids. Megasporogenesis and embryo-sac development appear to be typical for the Gramineæ except for the number of antipodals, which varies from five to eight. J. L.

Cytological Basis of Genetical Interference.—J. B. S. HALDANE ("The Cytological Basis of Genetical Interference," *Cytologia*, 1931, 3, 54-65). The statistical distribution of chiasma frequencies observed in bivalents of eight angiosperm genera is shown to be of the type required to explain the genetical phenomenon of interference. J. L.

Sex Determination in *Begonia*.—M. D. PASTRANA ("Sporogenesis and Sex Determination in *Begonia Schmidtiana*," *Amer. J. Bot.*, 1932, 19, 365-84). The sporophyte of *Begonia Schmidtiana* bears 13 chromosomes in all tissues except those of the staminate flower where the number is 12. These chromosomes can be divided into four types on the basis of size differences; the fourth type is unpaired and absent from the male flower. The staminate and pistillate flowers arise close together from a common axis which dichotomises. At the point of separation of the flower-buds the unpaired chromosome does not divide but passes whole into the female flower-bud initial. The nuclear behaviour at microsporogenesis is described and figured in detail, the chief points of interest being: pairing of threads is observed after synizesis in stages of the thicker spireme; segmentation of the spireme is delayed until diakinesis; there is a definite connection between the nucleolus and spireme. Meiosis in megasporogenesis is essentially the same as in microsporogenesis. The odd chromosome is easily recognized by its spiral shape, and seen to pass to the pole nearest the micropyle. Ultimately four megaspores are formed in linear arrangement, the two nuclei nearest the micropyle bearing 7 chromosomes, the two inner nuclei 6 chromosomes each. The odd sex chromosome enters the egg-nucleus. J. L.

Another Haploid *Nicotiana*.—F. A. MCCRAY ("Another Haploid *Nicotiana tabacum* Plant," *Bot. Gaz.*, 1932, 93, 227-30). From the cross *N. tabacum* var. *angustifolia* × *N. glutinosa* seed with good germination was obtained, but all the plants died at the seedling stage except one. This plant on maturity exactly resembled the female *tabacum* parent except for smaller size of certain features, especially the flowers. On cytological examination it was found to be haploid with 24 chromosomes. An irregular reduction division occurs in the pollen-mother-cells. No true metaphase plate is formed; four telophase groups are seen, but chromosome counts could not be obtained from these nuclei though it is certain that the original chromosomes have divided. No progeny was obtained from selfing or crossing the haploid. J. L.

Cytokinesis in Papaver Hybrids.—KONO YASUI ("Cytological Studies in Artificially Raised Interspecific Hybrids of *Papaver*. III. Unusual Cases of Cytokinesis in Pollen-Mother-Cells in an F_1 Plant," *Cytologia*, 1931, 2, 402-19). Cytokinesis was studied in the pollen-mother-cells of an artificially raised interspecific F_1 plant of *Papaver somniferum* \times *P. orientale*. After the heterotypic division the middle lamella initial (MLI) at the equator of the spindle is usually ephemeral. Several unusual types of cytokinesis occurred in the same anther: (1) the MLI persists through the second division but no cleavage furrows appear at interphase; (2) the MLI persists and cleavage furrows appear on both sides followed by protrusion of callose from the mother-cell wall; (3) cleavage formation from one side only generally resulting in incomplete cell-division; (4) as a result of incomplete nuclear division the two daughter nuclei are connected and the notch of the constricted pollen-mother-cell is filled with callose; (5) a reconstruction nucleus is formed and MLI and cleavage furrows may or may not appear. Staining with coralline soda solution indicates the callose nature of the MLI and pollen-mother-cell wall. The MLI first appears as fine granules at the middle of the equatorial plane of the spindle, and deposition occurs towards the periphery. After homotypic division cytokinesis occurs in normal and abnormal pollen-mother-cells; i.e., pollen tetrad formation may be simultaneous or successive. Diads and triads were also seen. It is suggested that delay of the second division due to some external cause may result in the formation of cleavages and callose protrusions after the first division. J. L.

Secondary Association of Chromosomes.—W. J. C. LAWRENCE ("The Secondary Association of Chromosomes," *Cytologia*, 1931, 2, 352-84). Chromosome behaviour from diplotene to second anaphase in the pollen-mother-cells is described for *Dahlia Merckii* ($2n = 36$), *D. coccinea* ($2n = 32$), *D. coronata* ($2n = 32$), and *D. variabilis* ($2n = 64$). In these species there are two kinds of chromosome association: (1) Primary association which arises from prophase pairing and determines segregation, and (2) Secondary association which is a post-synaptic phenomenon arising at pro-metaphase and due to the general affinity of homologous chromosomes. This does not affect segregation. Primary association of chromosomes at metaphase is held to be solely due to the maintenance of chiasmata formed at pachytene. Diakinesis is a phase of strong repulsion between the pairs and members of each pair of chromosomes resulting in the peripheral distribution of the chromosomes. Only bivalents or multivalents which are materially connected by chiasmata survive this repulsion phase. After mid-diakinesis the repulsion diminishes and at pro-metaphase the chromosomes approximate. The close proximity and general affinity of homologous chromosomes results in secondarily associated groups at metaphase. The bivalents which thus associate secondarily are of similar size and configuration. Association is also seen in second metaphase. The theory of secondary association is discussed and evidence from the literature presented. It is claimed that secondary association is evidence of more remote affinities than can be expressed in primary association in a polyploid. The author discusses the influence of fixation, the correlation between allopolyploidy and secondary association and the value of this association as a criterion of homology. J. L.

The Progeny of a Heteroploid Nicotiana.—D. KOSTOFF and J. KENDALL ("The Progeny of a Heteroploid, (*N. tabacum* \times *N. Rusbyi*) \times *N. tabacum*, Plant," *Genetica*, 1931, 13, 17-26). *N. tabacum* var. *macrophylla* ($n = 24$) \times *N. Rusbyi* ($n = 12$) gave an F_1 intermediate in habit and showing 12 univalent and 12 bivalent

chromosomes at heterotypic metaphase in pollen-mother-cells. These F_1 plants were back-crossed with *N. tabacum* var. *macrophylla* and gave offspring varying greatly in appearance, fertility, and chromosome number. One plant showing 28 chromosomes at heterotypic metaphase and 52-54 as the sum of the two plates at homotypic metaphase was selfed. Its progeny varied in morphology and fertility. One plant with 27 heterotypic metaphase chromosomes and 53-54 on the homotypic plates was selfed. The morphology and cytology of the polymorphic progeny of this plant are described and figured. Some of the progeny were in habit similar to *N. tabacum*, some approached *N. Rusbyi*, others showed various gradations between these two species, and finally, others had little or nothing in common with the parental types. With regard to cytology, the parent heteroploid plant gave: (1) heteroploid progeny both like and unlike the parent in habit, and (2) plants with the haploid number 24 both like and unlike in habit. Meiotic irregularities in the progeny are proportional to the amount of abortive pollen and sterility of the plant. From this study it is evident that from such hybridizing new forms may be produced very readily. J. L.

Cytology of Virus-infected Potato Plants.—P. CLINCH ("Cytological Studies of Potato Plants affected with Certain Virus Diseases," *Sci. Proc. Roy. Dublin Soc.*, 1932, 20, 143-72). A cytological study has been made of the foliage and stems of different potato varieties affected with simple mosaic, interveinal mosaic, crinkle, Aucuba mosaic, streak, and leaf-roll virus diseases. The cell modifications of the mosaic infected portions are described in detail. A tendency to abnormal starch accumulation is characteristic of the chlorotic cells; large quantities of tannin and fat are also present. X-bodies are found in the chlorotic cells of the leaves in association with simple mosaic, interveinal mosaic, crinkle, and streak; but were not seen in Aucuba mosaic or leaf-roll plants. They do not occur in healthy leaves. They are described in living and in fixed material. In appearance and staining properties the X-bodies resemble vacuolate protoplasm and usually occur as rounded masses lying in the cytoplasm near the nucleus. They contain mitochondria and at certain stages are associated with fatty globules. There are no structures within the bodies which could be interpreted as nuclei. It is suggested that the X-bodies arise as a result of viscosity changes in the cytoplasm of the diseased cells, but the initial cause of the changes is unknown. The fact that X-bodies are found associated with some virus diseases and not with others indicates their possible use in the classification of these diseases. J. L.

Anatomy.

Wood Structure of Rhoiptelea.—Y. TANG ("Timber Studies of Chinese Trees. I. Timber Anatomy of Rhoipteleaceæ," *Bull. Fan Mem. Inst. Biol.*, 1932, 3, No. 10, 127-31, 1 pl.). The wood structure of *Rhoiptelea chiliantha* Diels & Hand. of the new family Rhoipteleaceæ is described from the examination of a specimen taken from a bough 4.5 cm. in diameter consisting of eleven growth rings. The salient anatomical features of the wood are as follows. Growth rings distinctly marked by a band of parenchyma cells, three to five cells wide. Vessels evenly distributed, solitary or in radial groups of two to four; tangential diameter of largest vessels 0.14 mm.; vessel segments up to 0.72 mm. in length, perforations exclusively scalariform with few bars (commonly four to eleven); intervascular pits rather small and not crowded, circular border with elliptic aperture. Ground tissue composed of libriform fibres, about 1.4 mm. long, usually arranged in regular radial rows, commonly with a gelatinous layer, with very few and

indistinct bordered pits on radial surface. Wood parenchyma terminal and vasicentric. Rays heterogeneous, about ten per millimetre, one to four cells wide, and up to forty cells high. From the structure of the wood the species has closer affinities with *Ulmaceæ* than with *Juglandaceæ*. B. J. R.

Wood Structure of the Sterculiaceæ.—M. M. CHATTAWAY ("The Wood of the Sterculiaceæ. I. Specialization of the Vertical Wood Parenchyma within the Sub-family Sterculiæ," *New Phyt.*, 1932, **31**, 119–32, 2 pls.). On the grounds of the wood structure of the arborescent genera in the Sterculiaceæ it is suggested that the existing classification of the family should be revised. Two distinct lines of specialization within the family are recognized, the one affecting the vertical wood parenchyma and the other involving an elaboration of the tissues of the rays. (The specialization of the rays will be dealt with in a subsequent paper.) In the sub-family Sterculiæ the distribution of the wood-parenchyma shows great variation. Three distinct types are recognized, those with very little parenchyma (Type A), those with rather more parenchyma localized in tangential lines (Type B), and those with broad bands of metatracheal parenchyma (Type C). The character of the parenchyma cells in the three types shows a progressive specialization from Type A to Type C, and this is also seen in the length of the vessel segments, which is smaller in Type C than in Type A, with Type B intermediate. *Heritiera* and *Tarrietia* differ in many respects from the other genera of the Sterculiaceæ and it is suggested that they should not be placed in this sub-family. B. J. R.

Variation in the Wood Structure of Dicotyledonous Trees.—H. E. DESCH ("Anatomical Variation in the Wood of Some Dicotyledonous Trees," *New Phyt.*, 1932, **31**, 73–118, 11 figs.). The relative accuracy of different methods of measuring the saturated volumes for specific gravity determinations was examined; the differences due to different methods were found to be unimportant. From a study of the range in cell-size in any one sample it is recommended that mean figures should be based on not less than 300 measurements in each case. A positive correlation exists between annual increment and cell-size at a given height in the tree; fluctuations in the annual increment due to suppression coincide with fluctuations in cell-size. In the case of vessels radial diameter generally shows a closer correlation with annual increment than does the tangential diameter; it is suggested, therefore, that the tangential diameter, being less affected by changing conditions of growth, is the better feature of the two for purposes of identification. Variation in fibre length at different heights in the tree was found to be in conformity with the variation in tracheid length in conifers, in that there was an increase in length upwards to a certain height and then a decrease to the top of the bole. At a given height in the tree specific gravity tends to be low at the centre and to increase outwards for a period before decreasing towards the outside. No close relationship was found between specific gravity and cell-size or the proportion of different tissues or annual increment. Although there was no general relationship to be observed between specific gravity and ring-width, sudden marked fluctuations in ring-width generally coincided with fluctuations in specific gravity. With the exception of one species, *Baikiaea plurijuga* Harms, from Northern Rhodesia, the woods studied in the course of the investigation were diffuse-porous temperate hardwoods commonly grown in England, namely, species of *Alnus*, *Betula*, *Fagus*, *Populus*, and *Acer*. B. J. R.

The Anatomical Structure of certain Ceylon Woods.—C. P. JAYAWARDANA ("The Anatomical Structure of certain Ceylon Woods," *Ceylon J. Sci.*, 1932, **11**, 307–18, 3 pls.). Macroscopic and microscopic descriptions of the structure

of seven timbers commonly used in Ceylon are illustrated with photomicrographs at a magnification of ten. The species dealt with are *Artocarpus integra* Merr. (*A. integrifolia* L.), *Chukrasia velutina* W. & A. (*C. tabularis* A. Juss.), *Melia composita* Willd. (*M. dubia* Hiern), *Azadirachta indica* A. Juss., *Berrya cordifolia* Burret, *Pityranthe verrucosa* Thw., and *Madhuca longifolia* Macbr. (*Bassia longifolia* L.). In all cases except one the description is based on two specimens of the wood. B. J. R.

The Identification of Timber Specimens and Fossil Woods.—H. BANCROFT ("On the Identification of Isolated Timber Specimens, with Especial Reference to Fossil Woods," *Ann. Bot.*, 1932, 46, 353-66, 1 pl.). The author stresses the danger of comparing fossil with modern types without a sufficiently wide knowledge of living wood-structures. Instances are cited of the occurrence of a similar generalized type of wood-structure in widely distributed genera. This is particularly well marked when the transverse section only is available for examination. From modern work on the structure of recent timbers it is becoming increasingly evident that wood from the same species varies in structure under different conditions of soil and climate and that wood from the same tree may vary with position in the tree, or change of external conditions. The author advocates extreme caution in giving to fossil woods generic names which indicate affinity with recent genera; in many cases it is preferable to use the old generic name *Dryoxylon*, possibly with a specific epithet suggesting similarity with a recent genus. Where it is impossible to decide upon any one definite comparison among many possibilities it is advisable to give a specific name descriptive of the horizon or locality from which the specimen was obtained. B. J. R.

Anatomy of the Banana.—ALEXANDER F. SKUTCH ("Anatomy of the Axis of the Banana," *Bot. Gaz.*, 1932, 93, 233-58, 10 figs.). In this paper the term axis is used to denote the rhizome or "bulb," the aerial stem and axis of the inflorescence. The material studied was the "Martini" variety of *Musa sapientum* subsp. *seminifera*, and also the variety "Gros Michel." No important differences in the anatomy of these two varieties were noted. The lateral buds on the bulb-like rhizome are situated opposite the leaves between the two free margins of the leaf sheath. For this reason it is suggested that the apparently lateral buds are really terminal ones which have been pushed to one side by the true lateral buds originally situated between it and the leaf. The lateral buds grow out when the leaf sheaths by which they were originally covered die away and produce "large thick scales, representing the leaf sheaths alone." These leaf sheaths subsequently bend upwards raising the rudimentary false stem, and eventually the upwardly directed growing point develops into a new "bulb." Within the thick cortex there is a plexus of bundles whose direction is chiefly horizontal, but there is a narrow zone within the horizontal bundles where there are others whose course is mainly longitudinal. The primary bundles produced by the apical meristem are collateral. However, at a very short distance behind the apical meristem a cambium arises which produces the adventitious roots and the bundles connecting them to the leaf trace bundles. The secondary bundles formed by the activity of the cambium are amphiphloic in structure. It is stated that no single cambium cell divides more than seven times, but the cambium is constantly renewed from the inner cells of the cortex. The cambium gives rise first to the longitudinal amphiphloic bundles, and the primordia of the adventitious roots. An enzyme secreted from the tips of the adventitious roots by dissolving the cells facilitates their progress through the cortex. The course of the leaf trace bundles

is very complex. Some of them penetrate to the centre of the bulb while others do not, but in any case they pass into the secondary tissue already mentioned. It thus happens that the longitudinal bundles are downward prolongations of the leaf traces. At their lower ends, where they are in secondary tissues, they are amphiphloic but in the primary tissues they are collateral. The horizontal bundle complex serves for the conduction of water from the roots to the leaves. There are no secondary tissues in the aerial stem, and no endodermis (an endodermis is present in the underground portions), and the course of the bundles is less complex. Individual tracheids in the aerial stem and leaf sheath are mostly 4-6 cm. long, but in some instances attained a length of 7 or 8 cm. The latex vessels are formed from chains of large cells whose end walls break down to form wide perforations.

C. R. M.

Anatomy and Physiology of the Phloem of *Cucurbita* spp.—ALDEN S. CRAFTS ("Phloem Anatomy, Exudation, and Transport of Organic Nutrients in Cucurbits," *Plant Phys.*, 1932, 7, 183-225, 6 pls., 1 fig.). The material used was *Cucurbita Pepo* and *Cucumis sativus*. Sieve tubes in these species are not confined to the vascular bundles, but consist of: (1) Central tubes of the phloem, with poorly staining contents, and consisting of short, broad elements. (2) The narrower, longer sieve tubes of the periphery of the phloem. (3) Tubes described as ectocyclic and entocyclic, according to whether they are situated in the parenchyma between the epidermis and the sclerenchyma ring or between the sclerenchyma ring and the vascular bundles. The contents of the tubes in classes (2) and (3) stain deeply. (4) Commisural tubes, similar in structure to those of class (2), which serve to connect the various longitudinal sieve tubes. The young sieve tubes of the bundles can first be distinguished by their having slime drops and pitted end walls. The slime drops subsequently enlarge and small vacuole-like spots are formed within them. The first protoplasmic strands of the sieve field can now be recognized, and the first traces of the callus cylinders, which eventually surround the strands, appear. The vacuoles coalesce to form one large vacuole, and the nucleus, which is still present, is enlarged and stains less deeply. "The sieve plate thickens, the original protoplasmic connections apparently fuse to form a single strand in each field, and the callus cylinders enlarge and elongate." The viscosity of the cytoplasm immediately on the inside of the cell wall increases, the slime drops enlarge further, and the vacuoles within them increase in size and number. An inner network of protoplasmic strands becomes fixed to the sieve plates of the end and side walls, loses its fluid consistency and becomes relatively inert. "The material resulting from the (subsequent) disintegration of the nucleus and slime drops forms a colloidal suspension in the vacuole, and it is the coagulation and aggregation of this material which makes up the amorphous content of slime plugs in mature sieve tubes." The formation of slime plugs is due to killing reagents or gravitation and is not related to normal sap flow. Sieve tubes which arise at the periphery of the phloem or in the cortex (classes (2)-(4) mentioned above) are similar to those of type (1) in the early stages of their development, but at maturity the internal protoplasmic network is lacking, the sieve plate is less thickened, and the vacuolar contents take on a granular appearance and become more and more dense. Eventually the tube is completely filled with amorphous material formed by the transformation of the granular contents, and callus is laid down. Slime plugs were not observed in tubes outside the phloem groups. The later portions of the paper are purely physiological, being concerned chiefly with the mode of translocation of material through sieve tubes. "The only continuous permeable phase throughout the plant is the cell wall. In phloem

it is highly hydrated, shows regularity of structure, and occupies about 30 p.c. of the total volume in fresh sections. Calculations show that exudation from cut peduncles cannot be explained on the basis of mass flow through perforations in the sieve tubes. It seems possible that movement may take place partly through sieve tube lumina and partly through phloem walls." C. R. M.

Root Structure of *Sagittaria*.—CHARLES F. SEVERIN ("Origin and Structure of the Secondary Root of *Sagittaria*," *Bot. Gaz.*, **93**, 1, 93-9, 20 figs.). A study based on material of the various forms of *Sagittaria latifolia*. All roots, whether primary, secondary, or adventitious, have in common the same histogenic regions: calyptragen, dermatogen, periblem, and plerome. The author was unable to determine definitely whether the secondary roots arising from the adventitious ones originated from a single cell or a plate of cells in the pericycle, but considered the latter possibility more likely. The plerome of the rootlet arises from a plate of cells of which the central cell is more fully developed than the others. The calyptragen arises from cells which are pericyclic in origin, and not from cortical cells as has been suggested by some authors. Canals of two kinds containing air and latex respectively develop in the cortex. The air canals arise when the middle lamella splits at the corners of some of the cells, and later on the cells themselves become disorganized. The canals are interrupted at intervals by plates of living cells at right angles to the long axis of the root. The latex-containing spaces arise in the second hypodermal layer and are stated to look like and develop in the same way as resin canals. They are very much crowded and appear to be reduced in number by lateral pressure. C. R. M.

Unsegmented Latex Tubes.—GERHARD SCHAFFSTEIN ("Untersuchungen an unegliederten Milchrohren," *Beiheft. z. Bot. Centralbl.*, **49**, 1, 197-220, 11 figs.). The author confirms the opinion previously expressed by Schmalhausen and Chauveaud that the latex system in *Euphorbia myrsinites* and *E. Bojeri* arises from a few initial cells in the young embryo. The course and arrangement of the latex tubes varies in different species of *Euphorbia*, but the following features were common to all species: (1) The main course of the latex system, which extends to the growing point, but without reaching the actual apex, is parallel to the axis of the shoot. The distance behind the apex at which it stops varies in different species. The tubes branch more freely at the nodes than at the internodes, and in some species branching is confined to the nodes. Unsegmented latex tubes were also observed in *Urtica dioica* and *Vinca minor*. These were unbranched and of the same type as has hitherto been recorded only in the Cannabinaceæ. In *Stapelia bella* and *Trichocaulon* spp. there is in addition to the normal system of unsegmented tubes a system of segmented ones. It was found possible to ratify the theory that in *Euphorbia esculenta* growth of the tubes occurs only in the presence of tissues in which the capacity for cell division has not been lost. The growth of the tubes is thereby subjected to a controlling influence from the surrounding tissues, from which it follows that the growth of the tubes proceeds most actively near the growing point of the shoot. It is thought also that the course of the tubes and their manner of branching is governed by the other tissues. C. R. M.

Extrafloral Nectaries of the Angiosperms.—JOHANNES GEORG ZIMMERMANN ("Über die extrafloralen Nektarien der Angiospermen," *Beiheft. z. Bot. Centralbl.*, **49**, 1, 99-196, 4 pls., 46 figs.). It is impossible here fully to summarize the contents of this paper in which an account is given of an exhaustive study of extrafloral nectaries in the Angiosperms. Some idea of the scope of the

investigation may be gained from the following list of sections into which the paper is divided: (1) Morphological types of nectaries. The author divides nectaries into the following morphological groups: (a) Nectaries without form, e.g., the nectaries on the bracts of *Costus* spp. (b) Flat nectaries, i.e., those in which the secretory surface is not greatly raised above the level of the surrounding tissues. (c) Hollow nectaries in which the nectar-secreting tissue is in communication with the exterior only through a small hole. (d) Scale nectaries, which are saucer- or cup-shaped trichomes. (2) Topography of nectaries. Under this heading the distribution and types of nectaries present on different plant organs in a wide range of plants is discussed. (3) Anatomy of nectaries. This section contains detailed anatomical descriptions of nectaries under the following heads: (a) Structureless nectaries. These ill-defined nectaries are most easily recognized by their colour. They occur only on organs which have a short period of life. Secretion is effected through stomata. (b) Nectaries with a simple nectar-secreting tissue. (c) Nectaries with a palisade type of epidermis. (d) Nectaries of the nature of trichomes. (e) Nectaries formed by the metamorphosis of persisting organs. In all cases the taxonomic distribution of each of these types of nectary is discussed. (4) The liberation of nectar in the different families. (5) The distribution of nectar-secreting plants amongst the different families of Angiosperms. The author points out that nectaries are not universally distributed throughout the Angiosperms, but considers their distribution to be determined by physiological and morphological factors. Their occurrence within a family is usually sporadic; sometimes they are confined to certain genera, and only rarely are they present in a number of genera within a family. Their occurrence is not to be regarded as a feature of any systematic importance. (6) The geographical distribution of plants possessing nectaries. Hydrophytes, xerophytes, and halophytes usually have no nectaries, nor do the plants growing in dry habitats in Australia, South Africa, Chile, and California, as well as the arctic and antarctic plants which are physiologically dry. Nectaries are characteristic of plants growing in temperate climates, especially in Central Europe. (7) The function of nectaries. The author concludes that the primary function of nectaries is the local excretion of excess carbohydrates. About twenty-eight pages of the paper are occupied by a key to the distribution of different types of nectaries in various plant organs. There is a bibliography of eighty-six titles. C. R. M.

Morphology and Anatomy of the Fruit of *Hicoria pecan*.—DONALD V. SHUHART ("Morphology and Anatomy of *Hicoria pecan*," *Bot. Gaz.*, 93, 1, 1-20, 45 figs.). The first visible stage in the differentiation of the female inflorescence of *Hicoria pecan* is to be seen when the primordium of the floral axis appears in the centre of the previously broadened growing point. The individual flowers develop from primordia which are thought at first to be arranged spirally, but they appear as a cycle at a very early stage. Two of the upper leaf primordia develop into bracts which fold over the other members of the developing floral cluster. There are two or three bud primordia in the axil of each of these bracts, one of which sometimes develops into a female flower. The enlarged outer sepal of the first or second flower of the cluster, as well as the bracts which develop from the upper leaf primordia, have a protective function. The perianth of some of the flowers in the upper part of the inflorescence is sometimes two-lobed, owing to the failure of the flower to produce more than two sepal primordia. The cupule is "a specialized stem, and may be regarded as a cup-shaped receptacle dehiscing at four parenchymatous rays which are continuous with the edge of the sepals." Transverse sections show that the receptacle is composed of four segments of

tissue in each of which there is an outer and an inner ring of collateral bundles. The vascular supply to the sepals diverges from the outer ring of bundles. The bundles of the outer ring also extend inwards and downwards, thus forming an inner reversed ring. Near the base of the cupule they are again directed upwards so as to form a third cylinder, but this is confined to the base of the cupule. The stigmata are supplied by two groups of bundles which diverge from the reversed bundles near the top of two of the segments. The ovary is normally composed of two carpels which are laterally placed in relation to the axis of the inflorescence. The carpels continue to develop to form a tubular structure in the centre of which is the axis which develops independently to form a central placenta in which the nucellus and integument are laid down later on. Two large stigmata are formed by further growth of the carpels. A transverse section at the base of the ovule shows that the carpels have two dorsal and two septal bundles which arise from the third ring of bundles mentioned above. The carpellary cavity is at first unilocular, but later becomes bilocular in the lower part owing to the growth of the axis and the septum. (The mode of formation of the septum is uncertain, but the author considers that it may arise from two protuberances on opposite sides of the placenta and in a plane between the two carpels which "grow against and finally fuse with the inner edges of the carpels.") The carpellary tissues are differentiated into a hard, woody exocarp which constitutes the shell of the nut, on the inside of which there are ridges representing the hardened mesocarp. The endocarp, which is parenchymatous, is "pressed back and absorbed by the expanding integument." The orthotropous ovule arises in the tissues of the central axis. The integument is at first laid down at two points and always remains forked at the tip. The time of pollination varies with the season, but it usually takes place when the eight nuclei are developed in the megagametophyte. The nucleus is only partly covered by the integument at the time of pollination and is not completely enclosed until fertilization has taken place (usually within two weeks after pollination). A sac-like structure, apparently devoid of cell walls, is formed by the peripheral arrangement of the endosperm nuclei which divide frequently. The zygote remains inactive for several weeks at the micropylar end of the embryo-sac. The bifurcated cotyledons grow between the integument and the endosperm and eventually surround the latter before it is fully digested. The fruit of *Hicoria pecan* is regarded as a pome consisting of a specialized stem surrounding a normally two-carpelled but single-ovuled ovary. "It includes the true fruit, which is a nut formed by the lignification of the exocarp into a hard shell surrounding a single, loose, two-lobed orthotropous seed, the embryo of which has bifurcated folded cotyledons."

C. R. M.

Carpel Dehiscence in *Firmiana simplex*.—TSU-KIANG YEN ("Carpel Dehiscence in *Firmiana simplex*," *Bot. Gaz.*, 1932, 93, 205-212, 9 figs.). The young carpel of *Firmiana simplex* (L.) W. P. Wight, when only 0.21 mm. long, and when the placental bundles are scarcely differentiated shows a distinct narrow slit between the carpel edges. At this stage there is no epidermal cuticle and no stigma is developed. The five carpels of a common androgynophore are hoodlike with the broader portion below and with the sutures facing the centre. The suture continues to widen and reaches its fullest width when the carpel is 0.32 mm. long. After this, as cell division accelerates, the gap narrows and the margins are brought into close contact. The epidermal cells of the margins in contact continue to divide tangentially to the line of the suture. Eventually a complete coalescence is reached. When the carpel is about 1.6 cm. long the cells near the old line of suture both on the interior and exterior surfaces begin to separate, although the

other cells divide actively until the full size of the carpel, 7-10 cm., is attained. Later, a mechanical rupturing of the tissue along the old line of suture results in a new suture. Final dehiscence is merely a mechanical breaking of cell walls. At a very young stage of the flower the five styles coalesce to form a single column. The bases of the carpels are less closely joined. The stigmas, however, do not join up completely. After pollination the stigmas wither, the carpels separate below and eventually the style breaks off. A later and more complete separation of the follicles is accompanied by a development basipetally of a slender stalk to each follicle. The pistil may indicate an intermediate stage between apocarp and syncarpy. F. B.

Dehiscence of the Boll of *Linum rigidum*.—A. C. DILLMAN and J. C. BRINSMAD (‘‘Dehiscence of the Boll of *Linum rigidum* and Related Species,’’ *J. Agric. Res.*, **44**, 1, 21-7, 3 figs.). *Linum rigidum* and a few related species differ from other members of the genus in having fruits which dehisce only when they are wet. When dry they remain closed indefinitely. The mechanism which causes the fruit to open depends on the fact that each segment of the fruit is attached to the receptacle by a ‘‘hinge-like organ’’ consisting chiefly of cells incapable of absorbing water, together with a few colourless hygroscopic cells on the inside which absorb water very rapidly. When water is absorbed by the inner cells the force of their expansion causes the fruit to start opening within about 20 seconds. By alternate wetting and drying the fruits may be caused to open and close repeatedly without damaging the mechanism. Fifty-year-old fruits in the Washington herbarium also opened when moistened with water. The fruits do not open with sufficient force for the seeds to be dispersed without the additional aid of some such agency as beating rain or a high wind. C. R. M.

Thickness of Cuticle of the Fruits of *Vaccinium macrocarpon*.—NEIL E. STEVENS (‘‘Thickness of Cuticle in Cranberry Fruits,’’ *Amer. J. Bot.*, 1932, **19**, 432-5). Measurements were made of the cuticle thickness of the fruits of thirty-three varieties of cultivated cranberries (*Vaccinium macrocarpon*) from Massachusetts in 1929, 1930, and 1931. In 1929 the thickness of the cuticle in the different varieties varied from 9.9-13.7 μ and in 1930 from 8.7-10.5 μ and in 1931 from 9.0-10.6 μ , and in all varieties the cuticle was thicker in 1929 than in the two succeeding years. ‘‘This difference in the different crops does not appear to be correlated either with size of fruit or the keeping quality of the crop or with obvious differences in the weather conditions.’’ C. R. M.

Anatomy of Poppy Seed.—GEORG SCHWEIZER (‘‘Zur Anatomie des Mohnsamens (*Papaver somniferum* L.),’’ *Bericht. Deutsch. Bot. Ges.*, **49**, 8, 414-23, 9 figs.). The arched epidermal cells of unripe seed of *Papaver somniferum* L. contain large quantities of small grains of calcium carbonate. Beneath this is a single layer of thick-walled polygonal cells. The third or fibre layer consists of low, thick-walled cells which, as seen in surface view, have their greatest length parallel with the longitudinal axis of the seed. The cells of the fourth layer are only moderately thickened, they taper to points as seen in surface view, and have their long axis at right angles to the cells of the third layer. The net cells of the fifth layer are arranged as those of the fourth layer, and become obliterated in the mature seed. In surface view they appear warped and have pitted walls. The sixth layer is very difficult to see in transverse sections, but in surface view it appears as a thin-walled parenchymatous pellicle. In mature seeds the epidermal cells become keel-shaped and in conjunction with those of the layer beneath them constitute

the net-like covering. The different interpretations of the seed structure recorded by previous authors are discussed. C. R. M.

Anatomy and Microchemistry of the Cotton Seed.—R. G. REEVES and C. C. VALLE ("Anatomy and Microchemistry of the Cotton Seed," *Bot. Gaz.*, 1932, 93, 259-77, 21 figs.). The material used in the investigation consisted of varieties of *Gossypium hirsutum* L. and Pima and Sea Island cotton variously referred to as *G. barbadense* L. and *G. peruvianum* Cav. At the time of fertilization the tissues of the anatropous ovule with two integuments are undifferentiated except for the development in the outer integument of "balloon-shaped" protrusions representing the young lint hairs. In the embryo the cotyledons are bounded by an epidermis within which are two layers of palisade tissue and some spongy parenchyma. So-called resin glands present in the mesophyll were found to contain chiefly pentosans but also other substances. "Glands similar to or identical with those of the cotyledons were also found in the periblem of the hypocotyl near its attachment to the cotyledons." Oil was most abundant in the mesophyll of the cotyledons and in the parenchymatous cells of the hypocotyl. Starch was scarce, being found chiefly in the upper region of the hypocotyl. The quantity of starch present in the embryos of different individual seeds varied considerably. The soft, semi-transparent endosperm at the time when the embryo is 3 mm. long contains considerable quantities of starch, but in mature seeds the greatly reduced endosperm contains but little starch and considerable quantities of protein and oil. The perisperm, which usually consists of a single layer of cells, is stated to be the epidermis of the nucellus; at maturity its radial and transverse walls have tooth-like projections into the lumina. The innermost layers of the testa are thin-walled and filled with a brown pigment, but before they are mature they contain abundant starch. The hardness of the seed-coat is chiefly due to the presence of a single layer of palisade tissue, with very thick cell walls. These cells also contain brown pigment. Some variation was found to occur between the distribution of lignin in the palisade cells of *Gossypium hirsutum* and *G. barbadense* respectively. Pentosans mixed with other substances probably occur in the palisade layers of all the material examined. The palisade layer is enclosed by one or two layers of isodiametric, colourless cells whose walls give a positive reaction for lignin. Outside this is a layer of brown pigmented cells resembling those of the inner pigment layer mentioned above. Finally, the epidermis of the seed-coat consists of large, irregular cells with thick walls composed chiefly of cellulose. C. R. M.

Peltate Hairs of *Shepherdia canadensis*.—D. C. COOPER ("The Development of the Peltate Hairs of *Shepherdia canadensis*," *Amer. J. Bot.*, 1932, 19, 423-8, 1 pl.). The structure of the peltate hairs is so constant within the species *Shepherdia canadensis*, *S. argentea*, and *Elæagnus angustifolia* respectively that it is considered to be of taxonomic value in recognizing these species. In *S. canadensis* the shield arises from a single epidermal cell, and the stalk from adjacent epidermal and hypodermal cells. This mode of development is different from that described by previous authors for similar hairs in other families. C. R. M.

Factors Governing the Production of Cystoliths.—ANTON BERG ("Untersuchungen über die Entwicklungsbedingungen der Zystolithen," *Beih. z. Bot. Centralbl.*, 49, 1, 239-57, 6 figs.). The author agrees with Giesenhagen and Richter that the radial strings of cystoliths in the Urticaceæ and Acanthaceæ consist of canals filled with calcium carbonate. This is proved by their behaviour in polarized light. Cystoliths arise and develop in the same way in all the plants studied, but

their formation begins at an earlier stage in quickly growing plants than in slow-growing species of *Ficus*. Curtailment of light had no effect on the formation and development of cystoliths. This conclusion is the opposite of that held by Chareyres with regard to the cystoliths in the Urticaceæ and by Kohl for those in the genus *Ficus*. Similarly a deficiency of phosphorus, sulphur, magnesium, potassium, and iron respectively had no influence on their formation. When nitrogen was deficient there was a slight diminution in the calcium carbonate content of the cystoliths. When calcium was deficient there was considerably less calcium carbonate associated with the cystoliths which had been formed some time previously in old leaves, but in young leaves the cystoliths were impregnated with calcium carbonate in the usual way. The author considers that this indicates that the calcium carbonate originally present in the cystoliths in the old leaves was translocated and laid down afresh in the young leaf primordia. By growing seedlings in distilled water it was possible to obtain cystoliths entirely free from chalk, and thus to demonstrate that the presence of chalk is not responsible for the production of cystoliths. This does not support the conclusion of Kohl that cystoliths are merely of use in storing excess of chalk. If the lamina and veins or the midrib of young leaves of *Ficus* spp. are wounded by cutting them there is a marked inhibition of cystolith production at the distal end of the leaf where food supplies are short. No evidence was found to support the suggestion of Kohl that cystoliths become devoid of calcium in the autumn before the leaves fall.

C. R. M.

Statolith Apparatus in Seedlings.—LILIAN E. HAWKER ("A Quantitative Study of the Geotropism of Seedlings with Special Reference to the Nature of the Development of their Statolith Apparatus," *Ann. Bot.*, 46, 181, 121-57, 15 figs.). An account of an extensive investigation of the morphology and physiology of the statolith apparatus in seedlings of dicotyledons, monocotyledons, and conifers. The author found that the geotropical responses of seedlings could be explained in all cases in terms of the statolith theory of geotropism. This applies even in the case of seedlings with bilateral symmetry, since it was found in these plants that the statocysts are not isodiametric as seen in transverse sections. It thus happens that the statoliths in some statocytes have a shorter distance to fall than in others before reaching the sensitive protoplasm where they are capable of inducing stimulation. The morphology of the statolith apparatus was studied in about eighty species. Statoliths appear first in the root-cap of the radicle. In the hypocotyl or epicotyl of seedlings of dicotyledons statoliths are usually present only in the endodermis, but in a few arboreal dicotyledons and some monocotyledons and conifers there is a definite tissue (statenchyma) containing statoliths. It is of interest that in some monocotyledons, e.g., in *Allium* spp., the statoliths are chemically dissimilar from ordinary starch. Seedlings of monocotyledons and conifers were found, generally, to be less sensitive to gravity than those of dicotyledons; a correlation was found between the quantity of statenchyma present in all these three groups at different stages of development and the degree of sensitivity to gravity. A great deal of the work was purely physiological, being concerned with a determination of values for presentation and latent times during development for seedling organs of fifteen species chosen from amongst dicotyledons, monocotyledons, and conifers.

C. R. M.

Tropical Teratology.—J. C. COSTERUS and J. J. SMITH ("Studies in Tropical Teratology," *Ann. Jard. Bot. Buitenzorg.*, 42, 1, 1-22, 4 pls.). This paper is the last of a series describing plants with teratological structures collected in the tropics.

The descriptions are arranged under the headings of families to which the abnormal plants belong. With the present paper there is included an index to the abnormal specimens described in the whole of the series of papers. C. R. M.

Morphology.

Effect on Phyllotaxis of Isolating a Primordium.—MARY SNOW and R. SNOW ("Experiments on Phyllotaxis. I. The Effect of Isolating a Primordium," *Phil. Trans. Roy. Soc. Lond.*, Ser. B, 1931, **221**, 1-43, 17 figs.). *Lupinus albus* was chosen for the experiments because of its comparatively large leaf primordia. Its phyllotaxis belongs to the "Fibonacci" series of Church. The contact parastichies form a 2 + 3 system, or, if the stipular contacts are included, a 1 + 2 + 3 system. The mean value of the divergence angle of successive leaves along the genetic spiral was found to be 136.3° . The experiments consisted of partially isolating certain primordia from the rest of the stem apex by vertical tangential cuts with a "cataract" knife, the primordia remaining attached below the cuts. The primordia visible at the time of the operation were termed P_1 , P_2 , etc., P_1 being the youngest. Those still undeveloped at that time were called I_1 , I_2 , etc., I_1 being the oldest. The isolated primordia usually developed into normal leaves. In all experiments the growing point of the stem was displaced away from the wound. When P_1 was isolated, the angles subtended by I_1 and I_2 exceeded the normal, varying between 136° and 165° . The normal phyllotaxis was not seriously disturbed. When I_1 was isolated, the angle I_2 — I_3 increased enormously, ranging from 158.3° to 203.25° . Where this angle exceeded 180° the direction of the genetic spiral became reversed. The normal divergence angle was attained after a few leaves had been laid down. In three experiments where the angle was less than 180° the spiral became reversed. This arose from the fact that the stipules of I_3 were unequally developed and the larger gap between the stipules of I_2 and I_3 fell on the opposite side of the apex from the normal. The reversal of the genetic spiral depended, therefore, on the position of the larger gap between the next two primordia after the isolated primordium. A working hypothesis is adopted that each primordium arises in the first space that becomes both wide enough and distant enough from the growing point. The increased angle between the two primordia following the isolated primordium is due to the movement of the growing point towards the gap between them and the displacement of the second primordium in the direction of the wound. This displacement is shown to be due to three different factors working together. If I_2 is isolated, the results were sometimes essentially the same as when I_1 was isolated, the genetic spiral becoming reversed. Sometimes, however, another primordium, I_2' arose before I_3 obliquely above the wound or directly above it, and the spiral was then not reversed. These results are interpreted on the working hypothesis. The conclusion is reached that the positions in which primordia arise depend on the positions and shapes of previous primordia, and the results of the experiments strongly support the working hypothesis outlined above. F. B.

Morphology and Physiology of Viola.—ERNST BERGDOLT ("Morphologische und physiologische Untersuchungen über *Viola*," *Bot. Abhandl.*, 1932, **20**, Jena, Fischer, 1-120, 67 figs.). A very full account of extensive investigations of the morphology and physiology of a number of species of *Viola*. A description is first given of the comparative morphology and mode of development of the different types of leaf form found in the genus. *Viola pygmaea* differs from other members of the genus in having grass-like leaves, others such as *V. chrysantha* have

leaves with two pairs of pinnæ, whilst an intermediate stage between *V. chrysantha* and forms with only three principal segments is afforded by *V. Hallii*. A series of leaf forms intermediate between the scale-like leaves of *Violas* growing in high situations in the Andes and the typical lowland form *V. cotyledon* (*V. glacialis* and *V. aurea*) were also found. This is thought to indicate that the leaf form is liable to be modified by environmental conditions. An example of heterophylly is to be found in *V. Dubyana*. The comparative morphology of the stipules is next dealt with. These range in form from wing-like expansions at the base of the petioles to fringed or rounded leaf-like stipules. All stages between long-fringed stipules to those which are rounded and leaf-like sometimes occur on one stem. The stipules of *V. alba*, *V. elatior*, *V. sylvestris*, and *V. Riviniana* are not easily modified by external conditions. On the other hand, the length of the fringes on the stipules of *V. odorata* and *V. hirta* can be increased by cultivation under damp conditions. Under optimum manurial conditions (especially of nitrogen and carbon dioxide) they resemble the rounded "moor" form. Conversely the "moor" form can be induced to revert to the normal by experimental means. The stipules of *V. canina* also react in a similar manner. The stipules of *V. Schultzii* also became leaf-like when abundant nitrogen and carbon dioxide were available or when plants were exposed to continuous light for forty days. A high nitrogen content of the soil also induced a blue-green colour in the foliage of *V. Schultzii*. The production of anthocyanin pigment was favoured by treatment with carbon dioxide, but intense illumination was found to be more effective. Ultra-violet light favoured a rapid production of anthocyanin; but the same effect was obtained with light from other parts of the spectrum if the treatment was sufficiently intense and prolonged. Light rays of 300–400 μ caused the epidermal cells to become thicker, and the palisade cells to become elongated or even induced the formation of a second palisade layer. Intensive studies of the cleistogamous flowers found in the genus were also made. Three types of cleistogamy were recognized: (1) Temporary closure of the flower. (2) Permanent prevention of opening without reduction of the floral parts. (3) Permanent prevention of opening accompanied by reduction in floral structure (true cleistogamy). It was found that repeated self-pollination did not result in the production of plants bearing exclusively cleistogamous flowers, but Goebel's theory that cleistogamous flowers alone are produced early in the life-history of the plant was confirmed. Manurial treatment was found to exert a deciding influence in determining for some species whether cleistogamous or chasmogamous flowers were produced. The primordia of the various organs were laid down in all cases, but their development was inhibited by malnutrition. Complete inorganic manuring in conjunction with carbon dioxide treatment resulted in the exclusive production of chasmogamous flowers by *V. odorata*. Variations in the numbers of flowers were also found to be due to differences in illumination. Strong vegetative growth is accompanied by reduction in the size of the flowers in the *Melanium* group and by cleistogamy in the *Nominium* group. A number of teratological variations in floral structure were also studied. These included series of structures intermediate in character between sepals and petals and between petals and stamens. By suitable manurial treatments it was also found possible to induce the formation of dichasially branched inflorescences in *V. pinnata*. Abnormally large flowers in *V. tricolor* were obtained on the remaining shoots in plants from which most of the growing points had been removed two weeks previously. The colour of the flower was found in this species to be influenced by manurial treatment, and the age of the flower itself and the time of year at which it was produced. The paper ends with a bibliography of 107 titles.

C. R. M.

Regeneration in *Bryophyllum calycinum*.—ERNST NAYLOR ("The Morphology of Regeneration in *Bryophyllum calycinum*," *Amer. J. Bot.*, **19**, 1, 32-40, 13 figs.). As a result of an anatomical investigation of the leaves of *Bryophyllum calycinum* Salisb., the author claims to have shown that young plants, which arise by regeneration from the leaf-notches, are already present in mature leaves as preformed dormant structures. When the mature leaf is detached from the parent plant the dormant structures, each of which consists of a rudimentary stem tip, two leaf-primordia, two root-primordia, and a structure similar to the foot in fern embryos, become active and develop into young plants. The foot is always in contact with a vein in the parent leaf, so that a whole embryonic plant is thought to exist in each of the notches in a mature leaf. Studies of the anatomy of the leaf and embryo show that the latter is formed from a "small group of cells along the margin of the embryonic leaf," and that the notches are formed when the entire leaf is only a few millimetres long. The phloem cells of the parent do not take part in the formation of the embryo. C. R. M.

Formation of Fruit Buds.—THOMAS SWARBRICK and K. C. NAIK ("Factors Governing Fruit Bud Formation. IX. A Study of the Relation between Leaf Area and Internode Length in the Shoots of Worcester Pearmain Apple as affected by Six Different Vegetative Rootstocks," *J. Pom. and Hort. Sci.*, **10**, 1, 42-63). In the present investigation a study has been made of the leaf area and internode length of the apple "Worcester Pearmain" growing upon six different standardized vegetatively propagated rootstocks, with a view to elucidating their relationship to fruit bud formation. The rootstocks used in these experiments were Malling I, IX, X, IV, XII, and Bristol V. The mean length of the current season's shoots when worked on M IX was shorter than on the other five rootstocks, but no significant differences in internode length were found between trees worked on any of the remaining five rootstocks. Three definite regions in a current season's shoot could be recognized in passing from the base to the apex, in each of which the prevailing internode length was distinct. The region of maximum internode length was in each case towards the middle of the length of shoot produced in the current season. In trees worked on M IX the long internodes occurred very late in the growth period of the shoot as compared with those in trees on other stocks. The rootstock M IV, on the other hand, induces long internodes comparatively early in the life of a shoot. The first four internodes in all rootstocks were all of approximately equal length, and in only one case did it exceed 1.0 cm. Measurements of the leaf area were made by: (1) Multiplying the greatest length of the leaf by the greatest breadth. (2) By tracing the leaves on squared paper. It is of interest that in spite of the fact that the leaves are not rectangular the areas obtained by these two methods did not differ markedly from one another. The maximum difference between the "actual" and "calculated" area was found to be in the region where the leaves were largest and the internodes longest. The average area of the leaves varied according to the stock on which they were worked, but the size of the leaves did not correspond to the known vigour of each type of stock. As a result of studying the effect of different stocks on the ratio of leaf area to internode length it was found that trees worked on M IX had a ratio of 26.6, those on M I, M X, and M IV were 22.9, 21.6, and 21.0 respectively, whilst a third class consisted of M XII and Bristol V, for which the figures were 18.0 and 18.4. The size of the leaves in the terminal rosette was found to be modified by the different rootstocks although the number on each rosette was always three. A very high positive correlation was found between leaf area and internode length.

No evidence was found to support the suggestion of Pickering that the size of the sixth leaf from the tip of a shoot is an index of the general vigour of the shoot.

C. R. M.

Suspensor in *Cryptomeria*.—JOHN T. BUCHHOLZ ("The Suspensor of *Cryptomeria japonica*," *Bot. Gaz.*, 1932, 93, 221-6, 7 figs.). By dissection methods the author is unable to confirm Lawson's statement that "there may be one or several embryos developed from a single archegonium." The archegonia are terminal and grouped in a complex of ten or twelve. A number of instances occurred of two embryo systems coming from adjacent archegonia. All cells of a proembryo are potential embryo initials. Cleavage polyembryony is a characteristic feature of *Cryptomeria* and is probably characteristic of the Taxodineæ. No exceptions were found, out of twenty-five dissections, in which the entire zygote produced a single embryo. Prosuspensor cells may collapse completely if very long and with a large embryo attached. When they lose direct contact with an embryonic unit they may become inflated in the lower end and cut off abnormal embryonic cells. Embryos thus produced are retarded and very abnormal and probably do not contribute the successful embryo of the mature seed. The embryo initial which has a chance of becoming the successful one is borne on a vigorously elongating prosuspensor cell where it divides rapidly and becomes multicellular. A primary suspensor is not formed in *Cryptomeria*. An abrupt transition takes place between the prosuspensor cell to a massive secondary suspensor composed of many embryonal tubes. Evidence of apical cell growth was found in the embryos. The apical cell seems to have three cutting faces.

F. B.

Pleiomery and Meiomery in the Flower.—J. C. SCHOUTE ("On Pleiomery and Meiomery in the Flower," *Rec. Trav. Bot. Néerl.*, 1932, 29, 164-226, 35 figs.). The various explanations put forward by botanical authors for meristic variation in flowers are considered at great length. The author concludes that only Eichler's "original variation" hypothesis fits the facts, in which meristic variation is due to phyllotactical differences while at the same time in zygomorphic flowers pseudo-meiomery may be caused by abortion or fusion. The following views are rejected: (1) that pleiomery is due to fission, dédoublement, by intercalation of sectors in the floral receptacle, by coalescence of flowers, synanthly, or gamogemmy; (2) that meiomery is caused by fusion, abortion of organs, or by omission of sectors in the floral receptacle. On the basis of original variation the following facts are explained: (a) high numbers vary more than low numbers; (b) nutrition has a marked influence on meristic variation; (c) intermediate stages often occur between organs as broadened or bilobed members; (d) these transition stages may be classed in a continuous series though it is not apparent whether the series represents the doubling of one or the fusion of two phyllomes; (e) the middle stages of such a series vary more than the first or last; (f) supernumerary organs are more frequent in a calyx sector than in a corolla sector; (g) terminal flowers frequently have a different floral number from that of the lateral flowers in the same plant; this is strikingly shown in terminal peloria as in *Digitalis*. Experiments made on the Polygonaceous flower produced no definite results since several processes were found to affect the number of floral organs. The flower of *Lythrum Salicaria*, however, confirms several of the facts cited above. Twin flowers showed no transition to pleiomeric flowers. The vascular supply of abnormal flowers confirms the view that leaf traces are formed basipetally. Abnormal flowers also suggest that every floral whorl is formed anew by the linking up of a certain number of pre-existent phyllomes. Morphogenetic forces vary in the different zones.

Whether a stamen is epipetalous or episepalous is determined by the morphogenetic forces of the whorl to which it belongs. Thus, in a very early stage the episepalous stamen has a strong affinity for calyx veins and the epipetalous for corolla veins. Where there are two more stamens than perianth leaves, usually three of them are associated with a single calyx sector. If there are two stamens missing, two adjoining veins usually remain free. Thus, in both cases the alternation of the staminal whorls is maintained as well as the insertion on the appropriate veins. Where the number of stamens is odd, there is more chance that a single stamen will be intermediate in form since the formation of two whorls in the andrœcium meets with difficulty at one point. F. B.

CRYPTOGAMIA.

Pteridophyta.

Tracheids of Ophioglossaceæ.—GASPER A. LOUGHRIDGE ("Nature and Development of the Tracheids of the Ophioglossaceæ," *Bot. Gaz.*, 1932, **93**, 188–96, 24 figs.). Buds in Ophioglossaceæ consist of a series of three to five leaves, one of which reaches maturity each year. Rate of differentiation in the stem appears rapid, but in the leaf trace the process is slow. Lignification and maturation of the tracheids begins in the leaf four years before maturity. Archеспорial tissue is differentiated in *Botrychium virginianum* two years before the leaf reaches maturity. The tracheid walls consist of three distinct layers—the middle lamella; a secondary thickening of cellulose forming bars or scalariform markings; and a tertiary thickening of lignin covering the secondary thickening completely and giving rise to the characteristic bordered pits. Secondary thickening differs from that of the spermatophytes in respect to the substance present; and tertiary thickening also differs in that it almost completely covers the wall and gives rise to bordered pits, in contrast to the spiral markings of spermatophytes. A. G.

Buesia.—C. V. MORTON ("Buesia, a New Subgenus of Hymenophyllum from Peru," *Bot. Gaz.*, 1932, **93**, 336–9, 1 fig.). The type of the new subgenus *Buesia* is *Hymenophyllum mirificum*, a new species. It is a pendulous fern with flexuose rhachis, and is remarkable for the presence of true scales on stipes and rhachis, the subglobose receptacle, and the serrate ultimate segments. It has been gathered at five localities in Peru. A. G.

Matoniaceæ.—L. DIELS ("Matoniaceæ nova papuasica," *Notizblatt Bot. Gart. Berlin-Dahlem*, 1932, **11**, 311–12). Description of *Phanerosorus major*, a new species collected by G. Stein on Waigeu, an island north-west of New Guinea. It is nearly allied to *Ph. sarmentosus* from Borneo, and enlarges the distribution of the genus; it also adds another unexpected member to the limited group of the Matoniaceæ. A. G.

Spermatozoid of Pteris.—AKIRA YUASA ("Studies in the Cytology of Pteridophyta. I. On the Spermatozoid of *Pteris cretica* L. var. *albo-lineata* Hk.," *Bot. Mag. Tokyo*, 1932, **46**, 4–12, 4 figs.). The spermatozoid of *Pteris cretica* var. *albo-lineata* is a spiral of three coils, usually right-handed. The ciliiferous band can be traced from end to end of the body; the cilia grow out of one side of the band along the anterior half. The number of cilia varies from thirty to sixty-five on a spermatozoid. The two edges of the spermatozoid give a special staining reaction. Dehiscence of the antheridium is due to the swelling of the cell walls and also of the spermatogenous mass. After liberation the spermatozooids swim

freely with the help of the cilia; the direction of rotation is contrary to that of the body-spiral. The velocity of movement is about 1 mm. per second. A. G.

Teratophyllum.—R. E. HOLTUM ("On *Stenochlæna*, *Lomariopsis* and *Teratophyllum* in the Malayan Region," *Gardens' Bull. Straits Settlements*, 1932, 5, 245-313, 12 pls., 49 figs.). A revision of the much confused climbing genera *Stenochlæna*, *Lomariopsis*, and *Teratophyllum*. A historical summary of the work of previous authors is given; and, as a result of a study of the living plants and of all available herbarium material, the three genera are shown to be distinct. *Stenochlæna* is marked by a narrow row of areolæ along each side of the midrib of the pinnae, while in *Teratophyllum* and *Lomariopsis* there are no areolæ but the veins spring direct from the midrib. *Teratophyllum* has a slender cylindric rhizome, with small scales; and the terminal pinna is articulated. *Lomariopsis* has a stout flattened rhizome with large scales. The term *bathyphyll* is proposed for the peculiar juvenile leaves borne by *Teratophyllum* in the lowest stratum of the forest, that is, near the ground. The Malayan and Pacific species of the three genera are described, including two new species of *Teratophyllum*. Several new combinations are made. The morphological, anatomical, and developmental characters of the three genera are compared, and are considered to support their separation. *Stenochlæna* is regarded as of Pteroid affinity. *Lomariopsis* and *Teratophyllum* may be of kin with *Campium*. *Teratophyllum* has no relationship with *Asplenium epiphyticum*; the resemblance of the bathyphylls is superficial.

A. G.

Polyploidy in Ferns.—ELVA LAWTON ("Regeneration and Induced Polyploidy in Ferns," *Amer. J. Bot.*, 1932, 19, 303-33, 22 figs.). In the investigations described, apospory was induced in eleven species of ferns. The aposporous gametophytes of five species were heart-shaped and bore both archegonia and antheridia; their cells were larger than those of gametophytes grown from spores. Some ferns produced sporophytic buds and filamentous prothalli on the detached leaves; the sporophytes from the buds resembled normal plants. The aposporous prothalli of *Aspidium marginale* and *Woodwardia virginica* produced sporophytes from the sex organs; fertilization was observed in *Woodwardia*; chromosome counts showed that these plants were tetraploids. The leaves of the tetraploid sporophytes were abnormal in appearance and were composed of larger cells than the leaves of the diploid sporophytes of the same species. Apogamy does not necessarily follow induced apospory. *Pteris cretica* var. *albo-lineata* was normally apogamous and a regenerated prothallus of this fern was also apogamous. Some of the regenerated prothalli of *Aspidium marginale* bore sporangia and some contained stomata, epidermal cells, and tracheids together with prothallial cells. Sporophytes of *Woodwardia virginica*, which probably have the triploid chromosome number, were produced by crossing 2X plants with X plants. Gametophytes which were believed to have the 4X chromosome number were produced by regeneration from the leaves of *Aspidium* and *Woodwardia*. The 4X prothalli produced both archegonia and antheridia.

A. G.

Equisetum ripense.—F. MAEKAWA ("A New Species of *Equisetum*," *Bot. Mag. Tokyo*, 1932, 46, 188-91, 3 figs.). Description of *Equisetum ripense* Nakai & Maekawa, a new Japanese species allied to *E. ramosissimum* and *E. Sieboldii*. It is a taller plant than *E. ramosissimum*, with smaller uniseriate stomata and having very small granulated silex scattered on the epidermis. *E. Sieboldii* has a shorter smooth stem, six to ten very wide grooves on the stem, and stomata in two rows.

A. G.

Gametophyte of Selaginella.—RODNEY A. SLAGG ("The Gametophytes of *Selaginella Kraussiana*. I. The Microgametophyte," *Amer. J. Bot.*, 1932, 19, 106-27, 4 pls., 15 figs.). A re-investigation of the microgametophyte of *Selaginella*. The number of spores in a microsporangium is about 600. After microsporogenesis the microspore nucleus moves from a basal to an apical position while a large central vacuole is being formed. The *prothallial cell* is formed near one lateral coign; and no cellulose could be found in its wall. The *antheridial cell* becomes bisected vertically by a wall which intersects the prothallial cell wall. Each longitudinal half becomes divided by a wall, convex downward, near the level of the annular ridges; and these two walls coincide along their intersection with the first primordial wall, and together constitute the second primordial wall. In each upper quadrant two successive divisions produce three cells; these with respect to each other are placed as if two were the daughter-cells of the third. From the daughter-cells arise four primary spermatogenous cells, bounded exteriorly by periclinal walls curved in harmony with the microspore wall. Microgametophytes when shed are composed usually of thirteen cells: one is the prothallial cell; eight are jacket cells, and these enclose four primary spermatogenous cells. Jacket cells disintegrate during multiplication of the cells in the spermatogenous complex. The spermatogenous complex is composed temporarily of four genetic groups of cells, descendants respectively of the four primary spermatogenous cells. A single microgametophyte produces 256 antherozoids. A. G.

Isoëtes.—PIERRE ALLORGE ("L'*Isoëtes lacustris* L. dans la Chaîne Cantabrique," *Cavanillesia*, 1932, 5, 28-30). In a mountain lake beneath the Pico de Arvas in the western part of the Cantabrian chain plants of *Isoëtes lacustris* are fairly abundant; and this locality extends the known distribution of the species very notably towards the south-west. It is the only representative of the genus in the Iberian Peninsula. A. G.

Columbia Ferns.—WILLIAM R. MAXON ("Two New Ferns from Columbia," *Kew Bull.*, 1932, 134-6). Descriptions of two new species of *Dryopteris* collected by F. C. Lehmann in Columbia and preserved in the Kew Herbarium. A. G.

Java Ferns.—O. POSTHUMUS ("Note on some Java Ferns," *Bull. Jard. Bot. Buitenzorg.*, 1932, 12, 46-52). A series of critical notes on some Java ferns. A close comparison of *Anogramma leptophyllum* with *Monachosorum subdigitatum* shows that the latter fern must be transferred to the genus *Anogramma* and the genus *Monachosorum* must be suppressed. Various species of other genera are discussed and shown to be synonymous with earlier species. A. G.

Madagascar Ferns.—CARL CHRISTENSEN ("The Pteridophyta of Madagascar," *Dansk Botanisk Arkiv.*, 1932, 7, i-xv and 1-253, 80 pls.). A revised enumeration of the pteridophyta of Madagascar, with chapters contributed by H. Perrier de la Bathie (on distribution), A. H. G. Alston (*Selaginella*), and Johs. Iversen (*Isoëtes*), and notes on the various collectors and their travels. The work is in two parts: the first is a critical systematic revision of all the species hitherto recorded for the island, and contains keys to the species; and the second part is an analytical study of the distribution and relationship of the pteridophyta of Madagascar. A. G.

Ferns of New Hebrides.—E. B. COPELAND ("Pteridophyta" in A. Guillaumin: "Contribution to the Flora of the New Hebrides. Plants collected by S. F. Kajewski in 1928 and 1929," *J. Arnold Arboretum*, 1932, 13, 118-126).

A list of sixty-four species collected in Aneityum, Tanna, Eromanga, and the Banks Group. A. G.

New Caledonian Ferns.—A. U. DÄNIKER ("Ergebnisse der Reise von Dr. A. U. Däniker nach Neu-Caledonien und den Loyalty-Inseln (1924/6). 4. Katalog der Pteridophyta und Embryophyta siphonogama," *Vierteljahrssch. Naturforsch. Ges. Zurich*, 1932, 77, no. 19, 1-114). Included in a list of the pteridophyta of New Caledonia and the Loyalty Islands, determined by Carl Christensen. A. G.

Bryophyta.

Frullaniaceæ.—FR. VERDOORN ("Neue Beiträge zur Kenntnis Indomalaischer Frullaniaceæ (De Frullaniaceis IX)," *Bull. Jard. Bot. Buitenzorg.*, 1932, 12, 53-64, 1 fig.). A list of forty-two species collected in the Dutch East Indies by the author and others, with critical notes and the description of a new species. A. G.

Russian Hepaticæ.—ZOE SMIRNOVA ("Contribution to the Bryo-Flora of the Ural. I. Liverworts of the Middle and South Ural and Ural Region," *J. Soc. Bot. Russie*, 1931, 16, 519-36). Knowledge of the hepaticæ of Russia is not sufficiently complete to permit the distribution of the individual species to be defined. The present list treats of forty-three species collected in the Middle and South Ural mountains. For the whole Ural range sixty species have been recorded, thirteen of which are announced here for the first time. *Ptilidium*, *Marchantia*, *Chandonanthus*, and two species of *Lophozia* are of most frequent occurrence. A. G.

Japanese Hepaticæ.—YOSHIWO HORIKAWA ("Studies on the Hepaticæ of Japan. V," *J. Sci. Hiroshima Univ.*, Series B, Div. 2, 1931, 1, 55-76, 3 pls., 10 figs.). Descriptions and figures of eleven new species of Japanese hepaticæ, together with two new combinations. ("VI, VII," *Op. cit.*, 1932, 1, 77-94, 2 pls., 17 figs.; 121-34, 3 pls., 9 figs.) Descriptions and figures of twenty new species of Japanese hepaticæ. A. G.

Epiphyllous Hepaticæ.—YOSHIWO HORIKAWA ("Die epiphyllen Lebermoose von Japan," *Bot. Mag. Tokyo*, 1932, 46, 176-84, 1 pl.). An enumeration of twenty-seven hepatics which grow upon the living leaves of various trees, shrubs, plants, and ferns in Japan, with their localities and habitats. Descriptions of four new species are included. A. G.

Polytrichum Transpiration.—NELLIE M. BLAICKLEY ("Absorption and Conduction of Water and Transpiration in *Polytrichum commune*," *Ann. Bot.*, 1932, 46, 289-300, 4 figs.). An account of some experiments which show that in *Polytrichum formosum* and *P. commune* an eosin solution passed up the central strand of the gametophyte, through the foot of the sporophyte, and into the central strand of the seta. The rate of ascent of the eosin was determined. The transpiration rates for cut stems were obtained by using weight potometers; and the method is described. The transpiration rate of a *Polytrichum* shoot, growing *in situ*, was measured by passing dry air through a chamber enclosing the leafy portion, and absorbing the water vapour lost by the plant with phosphorus pentoxide. And the conclusion was reached that the central strand plays an important part in the conduction of water in *P. commune*. A. G.

Cinclidotus riparius.—W. E. NICHOLSON ("*Cinclidotus riparius* (Host) Arnott as a British Plant," *J. Bot.*, 1932, 70, 110-12). This moss was first

found in Britain in 1890, in the river Teme near Ludlow, and was figured in Braithwaite's Moss Flora in 1895; but subsequently it came to lie under a cloud of suspicion as not being of the true species. And it was not till the end of 1930 that all doubt on the question was dispelled by Dr. P. Culmann. *C. riparius* is now accepted as a British plant, and has been recorded from Shropshire, Worcestershire, and Herefordshire. But in this country only female plants have been found, with archegonia but no fruits. The species differs from *C. fontinaloides* in having a terminal female inflorescence as well as lateral. A. G.

Spanish Mosses.—I. THÉRIOT ("Mousses de la Sierra Nevada récoltées par le Dr. R. Maire en 1925," *Cavanillesia*, 1932, 5, 36–40, 1 pl.). A list of twenty-four mosses collected on the Sierra Nevada, including a new species *Bryum perremotifolium*, a *Brachymerium* which is new for Spain, and a moss the genus of which cannot yet be determined with certainty. A. G.

Corsican Bryophytes.—C. SARRASSAT ("Muscinées récoltées en Corse au cours de la Session de la Société botanique de France du 4 au 14 août 1930," *Bull. Soc. Bot. France*, 1932, 78, 689–92). An annotated list of the mosses and hepatics collected in the height of summer during a brief visit to Corsica. Six species are new records for the Corsican flora. A. G.

Tunisian Bryophytes.—MAURICE BIZOT ("Contribution à la flore bryologique de Tunisie," *Bull. Soc. Bot. France*, 1932, 78, 724–6). Some small collections of bryophytes made in the spring of 1929 at Tunis, Carthage, Dougga, Gabès, Djebel-Bou-Kournine, Gightis. A. G.

Thallophyta.

Algæ.

Polish Peridineæ.—JADWIGA WOŁOSZYŃSKA ("Peridineen des Hochmoors 'Kopytowiec' in Poturzyca bei Sokal," *Acta Soc. Bot. Poloniae*, 1930, 7, 499–505, 2 tabs., 1 fig.). Descriptions of a new form of *Peridium elegans*, a new variety of *Hemidinium nasutum*, and the spiny cysts of an unknown *Gymnodinium*. A. G.

Characium.—M. O. P. IYENGAR and M. O. T. IYENGAR ("On a *Characium* growing on *Anopheles* larvæ," *New Phyt.*, 1932, 31, 66–9, 1 pl., 1 fig.). Description of a new species of *Characium*, named *C. Anophelesi*, which is frequently observed to grow densely on the larvæ of six species of *Anopheles* in ponds near Sonarpur in Lower Bengal. With it are associated young plants of *Cedogonium* and certain Vorticellæ. The actively moving larva appears to be a very suitable host, affording a good supply of CO₂ and excreta, and carrying the algæ at intervals to the surface and into the sunshine. The *Characium* grows and reproduces very quickly; and though the larva moults every three or four days, there are plenty of zoospores ready to settle on the new skin. The *Characium* is a pyriform cell; its contents divide into 2, 4, or 8 spores which escape through a rupture at the top of the cell. A. G.

Convergent Algal Epiphytes.—A. PASCHER ("Über drei auffallend Konvergente verschiedenen Algenreihen gehörende epiphytische Gattungen," *Beih. z. Bot. Centralbl.*, 1932, 49, 549–68, 1 pl., 13 figs.). An account of three epiphytic algæ which, though remarkably alike, yet belong to different families. These are *Raciborskia* Wolosz. (Dinophycæ), *Dioxys* (Heterokontæ), and *Bicuspidella* (Chlorophycæ). *Dioxys* and *Bicuspidella* are new genera, each represented by two new species; and a new species of *Raciborskia* is also described. A. G.

Volvocales.—FRANZ MOEWUS ("Volvocales-Literaturverzeichnis," *Beih. z. Bot. Centralbl.*, 1932, 49, 369-412). A bibliography of all the literature on the Volvocales published between 1850 and 1931. A. G.

Ceylon Diatoms.—B. W. SKVORTZOW ("Notes on Ceylon Diatoms. I," *Ann. Roy. Bot. Gardens, Peradeniya*, 1930, 11, 251-60, 3 pls.). A list of seventy-six species and twenty-three varieties and forms of diatoms obtained from five samples of mud and roots collected by A. H. G. Alston at Peradeniya and other places in Ceylon. The novelties described are six species, eleven varieties, and eight forms. ("II," *tom. cit.*, 1932, 11, 333-8, 2 pls.) A list of forty species and two varieties of diatoms found upon a tuft of *Ceramium clavulatum* gathered by A. H. G. Alston near the shore at Gintota. One species and three varieties are new to science. A. G.

Indiana Plankton.—C. MERVIN PALMER ("Plankton Algæ of White River in Marion County and Morgan County, Indiana," *Butler Univ. Bot. Studies*, 1932, 2, 125-31). During thirteen months algæ from 176 samples of White river water were examined, having been collected at four different stations. A preliminary list of the algæ identified is given now, and in a later paper the effect of sewage on the algæ will be studied, and the periodicity of the species at the four locations will be shown. In the list 182 kinds of algæ are comprised representing eighty-four genera, twenty-six of which and 120 species are new records for the State of Indiana. A. G.

Fischerellopsis.—F. E. FRITSCH ("Contributions to our Knowledge of British Algæ. I. *Fischerellopsis*, a New Genus of Myxophyceæ," *J. Bot.*, 1932, 70, 121-31, 4 figs.). Description of *Fischerellopsis*, a new genus of Stigonemataceæ. In some characters it recalls the Stigonemataceæ, especially *Fischerella*, in others it resembles *Scytonema*, and in others again *Tolypothrix*. Two species are referred to it—*Fischerella moniliformis* Frémy from Tropical Africa, and a new species named after Mr. G. T. Harris who discovered it in East Devonshire. An account is also given of *Chrysopyxis stenostoma*, a Chrysomonad of frequent occurrence in Epping Forest, but not hitherto recorded for the British flora. It is normally found on *Mougeotia* and *Zygnema*. A. G.

Tetrasporidium and Ecballocystis.—M. O. P. IYENGAR ("Two Little-known Genera of Green Algæ (*Tetrasporidium* and *Ecballocystis*)," *Ann. Bot.*, 1932, 46, 191-227, 2 pls., 9 figs.). An account of the structure and development of *Tetrasporidium javanicum* with an amended diagnosis. The thallus consists of two perforated layers of cells, provided with numerous connecting processes. The "sporangia" described by Möbius are shown to be the effect of an attacking protozoon (*Vampyrella*) which engulfs the algal cells. As pseudocilia are absent, *Tetrasporidium* must be removed from Tetrasporaceæ to Palmellaceæ. An account is also given of the genus *Ecballocystis*, and a number of new species and varieties from S. India are described. The specific differences are related to the varying behaviour of the daughter-cells after division, which is invariably unique. The cells contain two or more discoid parietal chloroplasts with pyrenoids, and usually exhibit a marked polarity. Normal reproduction is by detached daughter-cells already enclosed by a membrane. The genus is possibly of kin with *Oocystis*; it is not closely allied with the genera of Chlorodendrales. A. G.

Missouri Algæ.—FRANCIS DROUET ("A List of Algæ from Missouri," *Bull. Torrey Bot. Club*, 1932, 59, 289-300, 2 pls.). A list of about 220 freshwater algæ collected in the State of Missouri during the past three years, with a description of the different districts and waters examined. A. G.

Prasiola.—YOSHITADA YABE ("On the Sexual Reproduction of *Prasiola japonica* Yatabe," *Sci. Rep. Tokyo Bunrika Daigaku*, Sect. B, 1932, 1, 39–40, 1 pl.). A posthumous paper on *Prasiola japonica*, found in rapid streams and used as an article of food. The cells of this unilamellate plant are arranged in fours and have a diameter of 7μ . Each cell contains a characteristic stellate chloroplast with a pyrenoid in the centre. Young plants appear in July and grow to a length of 10 cm. by November; and then sexual reproduction takes place by the production of planogametes, and the frond breaks up and disappears. The gametes are oval and biciliate. The macrogametes are twice as large as the microgametes; and both sorts are produced on the same frond from appropriate gametangia which have been formed in groups by the transformation of vegetative cells. The macrogametes and microgametes conjugate at their anterior ends, and the result is a spherical zygote which undergoes a long rest. A. G.

Chlorotylites.—MARSHALL A. HOWE ("Chlorotylites, a Fossil Green Alga from Alabama," *Bull. Torrey Bot. Club*, 1932, 59, 219–20, 1 pl.). Description of *Chlorotylites Berryi*, a siliceous fossil of Lower Eocene age from Sumter County, Alabama. It is regarded as having been a calcareous green alga resembling *Chlorotylum cataractarum*. A. G.

Galls on Chantrelaria.—KAROL STARMACH ("Die Bakteriengallen auf manchen Süßwasserarten der Gattung *Chantrelaria* Fr.," *Acta Soc. Bot. Poloniae*, 1930, 7, 435–60, 1 pl., 3 figs.). Description of the deformation of the filaments of several species of *Chantrelaria* under the attack of gall-forming bacteria in fresh water. A. G.

Laurencia.—YUKIO YAMADA ("Notes on *Laurencia*, with Special Reference to the Japanese Species," *J. Faculty Sci. Hokkaido Imperial Univ.*, 1932, ser. v, vol. 1, 183–310, 30 pls., 20 figs.). This paper originally appeared in "Univ. California Publications in Bot." with the same paging and plates. It represents a revision of the difficult genus *Laurencia* founded on a study of all the authentic material available in American and European herbaria, and a special investigation of the Japanese species. An artificial key to the species is provided and the following subgenera are defined—*Palisadæ*, *Fosterianæ*, *Cartilagineæ*, *Pinnatifidæ*. A. G.

Sargassum and Cystophyllum.—SHUMPEI INOH ("Embryological Studies on *Sargassum* and *Cystophyllum*," *J. Faculty Sci. Hokkaido Imperial Univ.*, 1932, ser. v, vol. 1, 125–33, 7 figs.). In a previous paper the author described three types of rhizoid formation in ten species of *Sargassum*. Upon further investigation he finds that *S. nigrifolium*, *S. micranthum* and *S. tosaense* belong to the sixteen-cell type; and that *Cystophyllum hakodatense* belongs to the four-cell type. In the genus *Cystophyllum* accordingly two types of rhizoid formation are distinguished, the four-cell type and the thirty-two-cell type. A. G.

Desmarestia Dudresnayi.—PIERRE DANGEARD ("La forme jeune du *Desmarestia Dudresnayi* (Lamouroux) Sauv.," *Bull. Soc. Bot. France*, 1932, 79, 25–8, 1 pl., 2 figs.). *Desmarestia Dudresnayi* is a deep-water species rarely gathered; its description was emended by Sauvageau in 1925. The juvenile state of the plant was unknown hitherto, and is now figured and described from specimens dredged early in July. They differ markedly from the adult plant in displaying branched pinnate hairs proceeding from the end of the costa and the lateral veins. These hairs are caducous, as in the case of *D. aculeata*. The plant would appear

to be an annual species and probably bridges over the winter season in the form of a minute prothallus at present unknown to us. The biggest of the young fronds examined bore a number of lateral frondlets attached by a narrow pedicel; these appear to become detached as the plant grows. A. G.

Development of *Zonaria*.—ARTHUR W. HAUPT ("Structure and Development of *Zonaria Farlowii*," *Amer. J. Bot.*, 1932, 19, 239-54, 4 pls., 4 figs.). A study of the structure and development of *Zonaria Farlowii*, a southern California species. The plants arising from a stipes are much branched, present a fan-shape, and are about 6 inches long. Transverse bands of erect unbranched hairs occur on the fronds. Growth takes place at the rounded distal margin through the activity of a row of initials; branching results from local death of marginal cells. The marginal initials cut off posterior segments in one plane, from which, by successive divisions parallel to the surface, the fronds become eight layers of cells thick; the superficial cells divide further at right angles to the surface, but the central cells do not. The male, female, and asexual individuals are superficially alike. Sexual plants are comparatively rare. Antheridia, oogonia, and sporangia are borne in sori on both sides of the fronds between the transverse bands of hairs. Paraphyses occur among the sporangia. Young sporangia arise only during a definite period of the lunar month. All three kinds of reproductive organs are subcuticular in origin, and burst through the cuticle at maturity. The formation of the oogonium, antheridium, and sperms is described. The sporangium has no stalk cell; the development is described; eight large aplanospores are produced; these are usually soon shed, but may germinate *in situ*. Adventitious fronds appear along the median line of the thallus on all three kinds of individuals.

A. G.

Algin.—T. MIWA ("On the Cell-wall Constituents of Brown Algae," *Bot. Mag. Tokyo*, 1932, 46, 261-2). Cellulose and alginic acid were found to be regular constituents of the cell wall of brown algae; cellulose occurs in the inner layer bordering on the cytoplasm, and alginic acid in the middle lamella. The cellulose of brown algae, hitherto recognized only by colour reactions under the microscope, was named algulose by Stanford, and was regarded as hemicellulose by Atsuki and Tomoda; but it is proved by the present author to be a true cellulose by means of acetolysis, and the cleavage product octacetylcellobiose has been isolated and identified by its melting-point and its specific rotation. Alginic acid is the chief constituent of the cell wall and is a polymerized mannuronic anhydride. It was claimed by Kylin that alginic acid occurs solely as a calcium salt in the cell wall; but this is shown to be incorrect. In *Undaria pinnatifida* there is three times as much alginic acid as there is calcium to combine with. But in what form the alginic acid occurs in the cell wall has yet to be determined. Nevertheless calcium is an essential constituent for the maintenance of structural stability of the cell wall. Fucinic acid is easily converted into alginic acid, and is only to be distinguished by a colour reaction with iodine. The amount of methylpentosan in brown algae seems to vary proportionally with that of the mucilage present.

A. G.

Alginic Acid.—T. MIWA ("Zur Kenntnis der Alginsäure. I," *Sci. Rep. Tokio Bunrika Daigaku*, Sect. B, 1932, 1, 23-37). An investigation of the chemical composition of the alginic acid obtainable from brown algae, preceded by a résumé of the results published by previous workers. The alginic acid of various brown algae was treated with hydrochloric acid, and extracted with ammonia, and by hydrolysis yielded cinchonin and brucin.

A. G.

Japanese Algæ.—YUKIO YAMADA ("Notes on some Japanese Algæ. III," *J. Faculty Sci. Hokkaido Imperial Univ.*, 1932, ser. v, vol. 1, 109-23, 5 pls., 5 figs.). Notes on ten marine algæ from Japan, including descriptions of four new species and three new combinations, with critical notes. A. G.

Indian Algæ.—F. BOERGESEN ("Some Indian Rhodophyceæ, especially from the Shores of the Presidency of Bombay. II," *Kew Bull.*, 1932, 113-34, 4 pls., 18 figs.). Eleven genera of Indian Ocean algæ are here treated. Four new species of *Acrochaetium*, one of *Grateloupia*, three of *Halymenia*, and one of *Chondria* are described. A new combination is made under *Agordhiella*. Critical notes are appended to several species. A. G.

Indian Algæ.—F. BOERGESEN ("Some Indian Green and Brown Algæ especially from the Shores of the Presidency of Bombay. II," *J. Indian Bot. Soc.*, 1932, 11, 51-70, 2 pls., 10 figs.). An account of some algæ collected mostly on the Bombay coast of India, including seven species of *Caulerpa* and one each of *Chaetomorpha*, *Vaucheria*, *Myrioglossa*, *Nemacystus*, *Stachospermum*, *Dictyota*. The reproduction of *Caulerpa* by swarm spores is discussed, and further evidence is invited. Australian, African, and Japanese algæ are found to occur in the northern part of the Arabian Sea. A. G.

Fungi.

Aquatic Phycomycetes.—F. K. SPARROW ("Observations on the Aquatic Fungi of Cold Spring Harbour," *Mycologia*, 1932, 24, 208-303, 7 pls., 4 text-figs.). Residence in the neighbourhood of Cold Spring Harbour, Long Island, N.Y., attracted the writer to a study of aquatic fungi. He passes in review genera and species of Chytridiales, Ancylistales, Monoblepharidales, Leptomitales, Saprolegniales, and Pythiales. The members of these orders have been studied by watching the growth of specimens on detritus, etc. Several new species have been determined and one new genus, *Physocladia*, belonging to the Cladochytriaceæ, the distinguishing character being the emission of the zoospores by the gelatinization of a papilla, and the zoospores forming an actively swarming mass confined in a definite vesicle. Fifteen of the species collected are new to America.

A. L. S.

Study of Sclerospora.—W. H. WESTON, Jr., and B. N. UPPAL ("The Basis for *Sclerospora Sorghi* as a Species," *Phytopathology*, 1932, 22, 573-86, 1 text-fig., 1 pl.). The fungus was first determined as a variety of *Sclerospora graminicola* by Kulkarni in 1913. The writers Weston and Uppal have made a study of the fungus, its structure and development, comparing these with *Scl. graminicola*. They have found structural differences and also differences in the plants which it has been possible to inoculate with the *Sclerospora*. A. L. S.

New Hosts for Downy Mildew.—B. N. UPPAL and M. K. DESAI ("Two New Hosts of the Downy Mildew in Bombay," *tom. cit.*, 587-94, 1 text-fig.). The mildew on maize has been found to be caused by *Sclerospora graminicola* var. *Andropogonis-Sorghi*; a study has been carried out by infection experiments and by comparison of the conidial phases. These are identical both on sorghum and on maize, but the sexual stage failed to develop on maize; the authors contend, however, that there is but one species. A. L. S.

Zoospore Formation in *Leptolegnia*.—A. C. MATHEWS ("Cytological Observations on Zoospore Formation in *Leptolegnia caudata* de Bary," *J. Elisha Mitchell Sci. Soc.*, 1932, 47, 281–92, 2 pls.). Mathews records the result of his study of the spores of *Leptolegnia*, more especially of the development of the two cilia. The research was made on living material and also on stained preparations. The cilia appear as short, bristle-like outgrowths from a depression at about the middle of the young spore, one being directed forward the other backward in the sporangium. They are directly connected with a chromatic body at the apex of the central body in the nucleus, and are entirely independent of the threads that connect the nucleus in the early stages of formation. A. L. S.

Study of Chytridiales.—W. R. IVIMEY COOK ("An Account of some Uncommon British Species of the Chytridiales found in Algæ," *New Phyt.*, 1932, 31, 133–44, 45 text-figs.). The author has described seven species of these parasitic water fungi from algæ found in ponds in various districts of the British Isles. He has been able, from the material at his disposal, to give descriptions of the whole development from the plasmodium stage to spore production. The Algæ infected were species of *Cedogonium*, *Ulothrix*, *Eudorina*, and *Spirogyra*. The fungi described belong to the genera *Woronina*, *Rhizophyidium*, and *Lagenidium*. A. L. S.

Fungal Parasites on Algæ.—JOHN N. COUCH ("Rhizophyidium, Phlyctochytrium, and Phlyctidium in the United States," *J. Elisha Mitchell Sci. Soc.*, 1932, 47, 245–60, 4 pls.). The genus *Rhizophyidium* includes about thirty water species parasitic mostly on algæ. The sporangia are sessile on the host-cell, which is pierced by their rhizoids. When mature they contain small uniloculated zoospores, in some species resting spores are also produced. *Phlyctochytrium* is distinguished by the presence of a subsporangial vesicle, *Phlyctidium* by the absence of rhizoids. Couch has given descriptions of all species found in the United States, with an account of the development stages; most of them are new to science. A. L. S.

Phytophthora on Lilac.—KENNETH S. CHESTER ("A Comparative Study of Three *Phytophthora* Diseases of Lilac and of their Pathogens," *J. Arn. Arbor.*, 1932, 13, 232–68, 2 pls.). Two species of *Phytophthora* have been recognized as causing disease of lilacs—*Ph. Syringæ* and *Ph. cactorum*, both of which have been found in America. Chester has undertaken the examination of these fungi and has added a third, which he refers to as Type A. He has made cultures of these three pathogens and gives details of his methods and of the media employed. He gives in a summary the data as to physiological characters, also as regards rate and type of growth, the formation of reproductive organs, the relation to temperature and reaction to pH. As to morphology only minor differences in the mycelium were observed in the three strains; the sporangia differed with respect to the papillæ of zoospore emergence; oospores were larger in *Ph. Syringæ*. On the basis of these observations it was found that Type A resembled *Ph. cactorum* more nearly than any other species and it is proposed to call it *Ph. cactorum* var. *applanata*, the form of the sporangial papillæ being somewhat different.

A. L. S.

Plasmopara Species.—LEO CAMPBELL ("Some Species of *Plasmopara* on Compositæ from Guatemala," *Mycologia*, 1932, 24, 330–2, 1 text-fig.). The writer notes that species of *Plasmopara* reported on Compositæ have been referred to *Plasmopara Halstedii*, with one exception. Examination of material was carried out on plants of Compositæ belonging to six different genera: most of the parasites belonged to *Plasmopara Halstedii*, but two species, *P. Palmii* and *P. Galinsogæ*, were determined as new to science and have been described.

A. L. S.

Roumanian Peronosporæ.—LR. SAVULESCU and T. RAYSS ("Nouvelle Contribution à la Connaissance des Peronosporacées de Roumanie," *Ann. Mycol.*, 1932, 30, 354-85, 27 text-figs.). This paper is a continuation of one published in 1930 in the same journal; forty species have been added to the previous account, including many new to science which have been figured as well as described. The authors' list for Roumania has reached in number 130 species of Peronosporacæ parasitizing 192 host-plants. A few species of *Cystopus*, *Plasmopara*, *Bremia* and *Basidiophora* are also included. A. L. S.

Study of Entomophthora.—OLIVE L. REES ("The Morphology and Development of *Entomophthora*," *Amer. J. Bot.*, 1932, 19, 205-17, 3 pls.). Many workers have studied the various species of *Entomophthora*, and the author has given an account of their results which are very varied. She then proceeds to describe her own methods and observations. The species in question, *E. fumosa*, is parasitic on the *Citrus* mealy-bug *Pseudococcus citri*. In the course of the investigation it was observed that spore sizes and forms differed considerably from those of *E. fumosa* and the species studied may require a new name. In the fungus she notes that no mycelium is observed in the vegetative growth: four-nucleate hyphal bodies fill the host. These four nuclei divide simultaneously and constriction of the fungus cell forms two daughter-cells. Descriptions are given of the hyphal bodies which multiply and fill the entire body cavity of the insect. The contents of the hyphal body then pass into the conidiophore, the nuclei having meanwhile increased by division. The formation of the conidia, which are four-nucleate, is described. Resting-spores are produced within the host as a result of the fusion of two adjacent hyphal bodies: they are binucleate and thick-walled. A. L. S.

Gibellula.—T. PETCH (*Ann. Mycol.*, 1932, 30, 386-93, 1 text-fig.). CAVARA in 1894 established the genus *Gibellula*—an *Isaria*-like fungus on spiders. The insect is covered with a web of mycelium from which arise erect clavæ—one to twenty or more; from the clavæ arise conidiophores bearing conidia. References are given to the various species of this genus and a description of *Gibellula aranearum* with many synonyms, such as *Isaria* spp. The perfect form of the fungus is *Torribiella Gibellule* Petch n.sp.; it was found on spiders in Ceylon and Trinidad. Another species on spiders, *G. alata*, is also described and figured. A. L. S.

Entomogenous Fungi.—T. PETCH ("Some Philippine Entomogenous Fungi," *tom. cit.*, 118-21). The fungi were collected in the Philippines by Mary S. Clemens and sent to Petch for determination. Though seventy-two specimens were collected only nine species were represented and, with one exception, were parasitic on Aleyrodidae. They were mainly species of *Aschersonia*, one of which proved to be a new species: it was the conidial stage of *Hypocrella philippensis*. The others are listed with the names of the plants frequented by the insects. These fungi are very numerous in the islands. A. L. S.

Hysteriales.—G. R. BISBY ("Type Specimens of Certain Hysteriales," *Mycologia*, 1932, 24, 304-29). Bisby includes eleven genera in his order Hysteriales. He has traced the original genera and species and dealt critically with all he has seen in the herbaria of England; also he has studied the collections in Europe and at Albany, New York. He has compared genera and species and given descriptions from his own study of the group. A. L. S.

Fertilization in Ascobolus.—G. SCHWEIZER ("Studien über die Kernverhältnisse im Archicarp von *Ascobolus furfuraceus* Pers.," *Festschr. zur Feier des*

50-jähr. Bestehens Deutsch. Bot. Ges., 1932, 50A, 14-23, 5 text-figs.). Schweizer has examined again this debated question, and as a result he finds that *Ascobolus furfuraceus* is of the same type as *A. citrinus* previously described by himself. In the archicarp instead of an influx of antheridial nuclei, he finds a passage of nuclei from neighbouring cells by pores in the cell wall. There is no fusion in the archicarp; the nuclei pass in pairs into the ascogenous hyphæ and fusion takes place in the ascus—the only caryogamy that occurs in the life-cycle. A. L. S.

Fertilization in *Pleurage anserina*.—L. M. AMES ("An Hermaphroditic Self-sterile but Cross-fertile Condition in *Pleurage anserina*," *Bull. Torrey Bot. Club*, 1932, 59, 341-45, 1 text-fig.). Cultures from single spores of normal bi-nucleate ascospores which occur four in an ascus were made. In some of the culture growths Ames found microspores on short branches of the mycelium, these cultures having developed from spores of asci which contained three bi-nucleate spores and two uninucleate: it was from the latter that these microspores were obtained. Each of these cultures developed both male and female organs—small spermatia (microspores) and large ascogonia with trichogynes—male and female organs but self-sterile. These transferred to other cultures resulted in the formation of mature perithecia. The non-production of mycelium from the microspores indicates that they do not function as conidia but as true spermatia. A. L. S.

Sex of *Neurospora* ascospores.—CARL C. LINDEGREN ("The Genetics of *Neurospora*. II. Segregation of the Sex Factors in Asci of *N. crassa*, *N. Sitophila*, and *N. tetrasperma*," *Bull. Torrey Bot. Club*, 1932, 59, 117-38, 5 text-figs.). In the development of the ascus of *Neurospora crassa* and *N. Sitophila* there are eventually eight uninucleate spores which on germinating give rise to a mycelium which may be either of two sexes: the mycelium alone is sterile and the fruit is not again formed unless the mycelia of two different sexes fuse. The difficulty has been to ascertain the position in the asci of the oppositely sexed spores, and at what stage of division sex segregations take place. This segregation is evidently not at the same time in the different species; the orientation of the nuclear spindle has helped to solve the problems. A. L. S.

Study of *Meliola*.—PAUL WEIDEMEYER GRAFF ("The Morphological and Cytological Development of *Meliola circinans*," *Bull. Torrey Bot. Club*, 1932, 59, 241-66, 2 pls.). Graff has studied more particularly the formation and growth of the ascocarp. He has found typical antheridia and oögonia. He has also found evidence that the species *M. circinans* is parasitic, attacking the host epidermis without penetrating the cell, but causing injury to the host. All details of growth and development have been worked out and the methods as well as results are described. He notes, among other characters, the growth of setæ, which he finds are not from the perithecium but are vegetative hyphæ produced from the hyphopodia or from the stromatic surface; this development serves to distinguish *Meliola* from allied genera. Finally, he classifies the genus among the Perisporiales rather than the Dothideales. *Meliola*, *Amazonia*, and *Asterina* are shown by a study of their development to be a closely related group. A. L. S.

Study of *Penicillium*.—MARJORIE E. SWIFT ("A New Ascocarpic Species of *Penicillium*," *Bull. Torrey Bot. Club*, 1932, 59, 221-27, 1 text-fig.). A very distinctive species of *Penicillium* was isolated from a water-soaked spot on a *Begonia* leaf. It was grown on a varied series of agar media—corn-meal agar, Czapek agar, Potato dextrose agar, Dextrose agar, Sabouraud agar, and Potato plugs. The mycelium showed marked differences of colour on these media, but in all

cases at some stage there was a green colour, though it varied to yellow, orange, and dull-red. These differences in colour were found not to be due to the amounts of acidity present nor to changes in temperature. The species is homothallic, and differs from other species in the form of the conidia which are less abundant than in some of the commoner species, and also in their elongate form. The ascospores are spherical, oval, or pear-shaped at first, and finely verrucose. The species *Penicillium bacillosporium* n.sp. is fully described and illustrated. A. L. S.

Function of Microconidia.—F. L. DRAYTON ("The Sexual Function of the Microconidia in certain Discomycetes," *Mycologia*, 1932, 24, 345-48). Certain structures in Discomycetes have been referred to as microconidia or spermatia, though their function has been doubtful. Drayton has examined these bodies as they occurred in *Sclerotinia* and *Botrytis*—the microconidia about 2-4 μ diameter, produced from "small, fasciculate, Indian-club-shaped conidiophores, arising from a single hyphal cell." These microconidia are produced in large numbers and are embedded in a mucilaginous matrix. Germination of the microconidia has not yet been successfully observed. Drayton states that developments of apothecia in *Sclerotium Gladioli* has been induced by placing the microconidia of one thallus on certain structures which were developed on another thallus. The process is described as spermatization, and comparison is made with Craigie's work on the spermatia of rusts. Further work on the subject is in progress. A. L. S.

Microconidia of Neurospora.—B. O. DODGE ("The Non-sexual and the Sexual Functions of Microconidia of *Neurospora*," *Bull. Torrey Bot. Club*, 1932, 59, 347-59, 2 pls., 1 text-fig.). Dodge describes first of all the formation of microconidia in *Neurospora*: they arise directly from individual cells of the branched microsporophore and act as spermatia in cultures of the fungus. He gives an account of the microconidia that have appeared in cultures of other fungi and how these conidia had been used successfully to spermatize. The mycelium to be spermatized should not be too old and the microspores should be obtained from fresh cultures. Dodge has applied these facts to the theory of origin of the ascomycetes and holds that the origin from red algæ becomes more plausible, and he also brings these data to bear on the meaning and origin of sex. A. L. S.

Study of Discomycetes.—J. A. NANNFELDT ("Studien über die Morphologie und Systematik der nicht-Lichenisierten inoperculaten Discomyceten," *Nova Acta Reg. Soc. Sci. Upsal.*, 1932, ser. iv, 8, 1-368, 19 pls., 47 text-figs.). This extensive work treats only of the *inoperculatae* among Discomycetes, that is, of those in which the ascus liberates the spores by a minute opening at the top. In the first chapter the author discusses the literature of the subject with criticisms of the different views held on the origin and systematy of the group. He differs from other mycologists in treating the open Discomycete as of an earlier type than the closed Pyrenomycete. In the second chapter there is a fully discussed account of classification resolved into two great groups: I. *Operculate*, and II. *Inoperculate*. The latter, with which this work is concerned, is divided again into (1) mostly associated with algæ (Lecanorales), and (2) free from symbiotic association (Non-lichenosis). There are further groupings into Saprophytes and Parasites. From p. 75 onwards, there is an account of the orders, families, and genera of the *Non-lichenosis* group, with special reference to the anatomy of the apothecium. The higher inoperculate Ascomycetes he considers fall into three groups—the Plectascales, the Ascoloculares, and the Ascohymeniales, the latter group including Discomycetes and Pyrenomycetes which have thin-walled asci,

thickened only at the apex—an apparatus for spore ejaculation. The relation of lichens to fungi is also dealt with: he judges that many of the more highly developed lichen genera and families form phylogenetic units, and cannot be traced to special fungi, although Discolichens are related to Discomycetes as Pyrenolichens are to Pyrenomycetes. Several lichens placed among fungi by Keissler and others are again classified as true lichens by Nannfeldt. Several new fungus genera have been established as a result of the research. A list of writers referred to in the text is given and a full index.

A. L. S.

Monograph of the Genus *Pestalotia*.—Part II. E. F. GUBA (*Mycologia*, 1932, 24, 355–97, 4 text-figs.). The author has based his determination of species of *Pestalotia* on morphological characters: “the variety of characters and size peculiar to the conidia of *Pestalotia* provide a reliable means of separating species.” He has found great constancy in size and form of conidia both in nature and in cultures. There is not much evidence of any pathological characters: some few species have acted feebly as wound parasites or have grown on dying material, “Against healthy tissue the fungus is completely innocuous.” In general, species are found on plant tissues dead or dying, or affected by other organisms. The author has described in this paper forty-two species, giving full descriptions and the plants on which they are to be found. A key to the whole genus is given.

A. L. S.

Study of Melampsoraceæ.—NAOHIDE HIRATSUKA (“Inoculation Experiments with some Heteroecious Species of Melampsoraceæ in Japan,” *Jap. J. Bot.*, 1932, 6, 1–33, 42 tabs.). Hiratsuka gives in his paper the result of many years’ inoculation experiments with this family of rusts, as a study of their life-history. His experiments have in many instances been successful and have increased our knowledge of the various host plants, and especially of the alternating hosts of the æcidial and teleuto- or uredo-stages. The results are clearly summarized in a series of tables.

A. L. S.

Reaction of Rusts to Host Modification.—DOROTHY F. FORWARD (“The Influence of Altered Host Metabolism upon Modification of the Infection Type with *Puccinia graminis-Tritici*,” *Phytopathology*, 1932, 22, 493–555, 11 text-figs.). Modifications of the host were secured by growth in darkness of wheat seedlings after the rust infections. It was found that the rust was retarded by the darkness period. Many experiments were carried out as to the period of retardation, the effect of interrupted darkness, and the effect of darkness on detached leaves. The question of metabolic changes in the host due to darkness have been considered and the effect on infection and growth of the fungus.

A. L. S.

Rusts of Onagraceæ.—GEORGE B. CUMMINS (“The Full-cycle Puccinias on Onagraceæ in North America,” *Amer. J. Bot.*, 1932, 19, 334–39, 4 text-figs.). The rusts on American Onagraceæ have been classified under one species, *Puccinia Epilobii-tetragoni*. A study of the fungus has convinced the writer that four already described species are concerned. He bases his conclusions on morphological grounds and especially on the teliospore which shows marked differences in all four. *Æcidia*, pycnidia, and uredospores are less distinctly different. Cummins emphasizes especially the position of the pore both in the upper and lower spore cells. The species are fully described and synonyms are cited.

A. L. S.

Terminology of the Uredinales.—J. C. ARTHUR (“Terminologie der Uredinales,” *Festschr. zur Feier des 50-jähr. Bestehens Deutsch. Bot. Ges.*, 1932, 50A,

24-7). Arthur criticizes recent attempts to formulate a suitable nomenclature for the many phases that occur in the life-history of the Uredinales. Finally, he selects, as the most appropriate terms, pycnium—pycniospore, æcium—æciospore, uredium—urediospore, telium—teliospore, basidium—basidiospore. He commends these terms as expressing in the shortest way the different stages of growth.

A. L. S.

Notes on Peridermium.—L. S. GILL ("Notes on the Pycnial Stage of *Peridermium cerebroides*," *Mycologia*, 1932, 24, 403-9, 3 text-figs.). The pycnia of this fungus were recorded for the first time on *Pinus radiata* and *P. attenuata*; they are rare and small, and have only been found on galls during the winter months. Their production and formation agree with other pycnia of the caulicolous *Peridermia*.

A. L. S.

Resistance to Smut Disease.—GEORGE M. REED ("Inheritance of Resistance to Loose and Covered Smut in Hybrids of Hull-less with Early Gothland and Monarch Oats," *Amer. J. Bot.*, 1932, 19, 273-301). The writer states that Hull-less is an oat variety very susceptible to the Missouri races of loose and covered smut; "Early Gothland" is highly susceptible to loose smut but almost immune to covered smut; "Monarch" was practically immune to loose smut, though susceptible to covered smut. Reid obtained hybrids between these two types of oats, but finds that the resulting plants were as susceptible as their parents to loose smut and to covered smut.

A. L. S.

Notes on Boletes. I.—WALTER H. SNELL (*Mycologia*, 1932, 24, 334-41, 1 text-fig.). The writer records the finding of a familiar European species, *Boletus porphyrosporus*, in one spot near Warrensburg, N.Y. He describes this species which, he considers, may have been introduced with seed, or with seedlings of forest trees. Notes on the determination of other species found in America are also contributed, many of them differing slightly from the European species under which they had been placed.

A. L. S.

Monograph of Russula.—R. SINGER ("Monographie der Gattung *Russula*," *Beih. Bot. Centrabl.*, 1932, 49, 205-380). Singer has given an exhaustive account of the genus *Russula*. The first thirty pages deal with the anatomy and development, and account of spore differences, with nine different types of spore ornamentation, the chemical reactions, and a discussion on the larger classification. The main part of the work deals with the species, which are arranged under five sections. Notes are given as to the determining characters and there follow descriptions of the known species, seventy-two in all. A number have been rejected as imperfectly described. An index completes the monograph.

A. L. S.

Study of Armillaria.—J. REITSMA ("Studien über *Armillaria mellea* (Vahl) Qué!," *Phytopath. Zeitschr.*, 1932, 4, 461-522, 11 text-figs.). *Armillaria mellea* is one of the best known autumn fungi of the woods and one of the most dangerous enemies of trees: from the base of the fungus the hyphæ spread and form thickish dark rhizomorphs pushing on towards other tree roots, thence travelling up the tree trunks with devastating effect. Reitsma has studied it from four aspects: (1) The manner of growth and the conditions that hinder or favour development. (2) The general physiology: the relation to acidity and temperature, with the nitrogenous and carbonaceous conditions. (3) The methods of checking the spread of the fungus: various substances are recommended for disinfecting the soil and destroying the rhizomorphs. (4) The influence of light on the develop-

ment and the importance of oxygen to the growing underground mycelium. Many students have worked at this tree pest and a long list of their writings is added.

A. L. S.

Tropical Phallineæ.—K. B. BOEDJN ("The Phallineæ of the Netherlands East-Indies," *Bull. Jard. Bot. Buitenzorg.*, 1932, 12, 71–102, 12 text-figs.). The author gives a complete list of the Phallineæ, peculiarly numerous in tropical lands; two families are included: Clathraceæ, with five genera, and Phallaceæ, with seven genera. Genera and species are fully described with locality and habitat, and most of the genera are illustrated. There are only nineteen species known so far. A long list of literature cited and an index complete the paper. A. L. S.

Phallus impudicus.—E. ULBRICH ("Über den Formenkreis von *Phallus impudicus*," *Festschr. zur Feier des 50-jähr. Bestehens Deutsch. Bot. Ges.*, 1932, 50A, 276–326, 4 text-figs.). Ulbrich gives us a detailed account of *Phallus impudicus* and its allies. He confirms previous opinion that *Ph. iosmos* and *Ph. imperialis* must rank as varieties, thus giving an enlarged form-circle to the species. Form differences as well as growth changes are described: branching of the receptacle or deeper forking with multiplication of openings at the top, etc. He also includes allied species from all over the world in his survey. A. L. S.

Soil Fungi of a Pine Forest.—MARIE BETZNER MORROW (*Mycologia*, 1932, 24, 398–402). Samples of soil were taken at a depth of 2–4 inches and were plated on artificial media. Thus far thirteen genera and some thirty species have been identified. *Penicillia* were not rare in the Texas soil whence the samples were taken: the dominant types being species of *Penicillium*, *Citromyces*, and *Aspergillus*. The other species determined are listed, a number of them new to Texas soil. A. L. S.

Fungi from Southwestern China.—S. C. TENG (*Contrib. Biol. Laboratory Sci. Soc. China*, 1932, 7, 69–127, 2 pls., 1 col.). The writer has studied and now enumerated the fungi that were found during an expedition for the collection of vascular plants. A very considerable number are listed with biological notes. They are mainly species of the larger fungi, both fleshy and woody. Teng describes a new genus of Lycoperdaceæ, *Verrucosia*, distinguished by the verrucose capitulum. A. L. S.

Australian Fungi: Notes and Descriptions—no. 8.—J. BURTON CLELAND (*Trans. and Proc. Roy. Soc. S. Australia*, 1931, 55, 152–60). Cleland describes thirty-four species of the larger fleshy fungi, all new to science. A detailed account is given of form, size, and colour as also size of spores, with notes as to manner of growth, smell, etc. A. L. S.

Entomogenous Fungi.—T. PETCH ("British Species of *Hirsutella*," *The Naturalist*, 1932, 45–9; "British Entomogenous Fungi," *tom. cit.*, 103–8, 133–6, 167–72). In these contributions to the "Naturalist," Petch has given an account of the fungi that live on insects in our country, thus considerably adding to our knowledge of these organisms. The first to be described belongs to a genus *Hirsutella*, considered hitherto to be confined to the tropics; it had been classified under *Isaria*. The other papers are publications of an address to the Yorkshire Naturalists' Union on fungi that grow on insects—among the best known, *Cordyceps militaris*; other species of the genus are also described with their conidial *Isaria* forms. He passes on to other parasitic groups, such as *Laboulbenia* and *Mucedinea*. They are still imperfectly known, but recognized British species now number

fifty-two. It has been suggested that every insect contains a symbiotic fungus which, when the insect dies, emerges as an entomogenous fungus. A. L. S.

Mycotheca germanica Fasc. L-LII—no. 2451-2600.—SYDOW (*Ann. Mycol.*, 1932, 30, 394-401). The fascicles include a number of new species which are fully described by the author—a species of *Entyloma* and six species of Fungi Imperfecti, new to science, are included. A. L. S.

Fungi in the Tropics.—F. L. STEVENS ("Tropical Plant Pathology and Mycology," *Bull. Torrey Bot. Club*, 1932, 59, 1-6). Stevens in his address to botanists at New Orleans in 1931, took Tropical Fungi as his theme. There is no great difference between tropical and temperate diseases, he stated; the well-known diseases of temperate climes are all there, only in greater abundance and destructiveness. Among the most virulent are the banana *Fusaria*, the coffee rust, *Hemileia*, etc. More than thirty fungi have been listed on rice, fifty on *Bambusa spinosa*. In the tropics the higher plants are in tremendous abundance and the profusion of hosts entails a profusion of parasites: *Meliolæ* are peculiarly numerous, so are many Hyphomycetes and Rusts. Dothidiales is one of the three largest orders of tropical fungi: more than forty species have been recorded on *Ficus*. Stevens urges the importance of studying these organisms and also of work in the field. A. L. S.

Dominican Fungi.—F. PETRAK and R. CIFERRI ("Fungi dominicani," *Ann. Mycol.*, 1932, 30, 149-353). The authors have given names, descriptions, and diagnoses of very many fungi—all of them microfungi on living or dead leaves, wood, etc. An account of Discomycetes and Pyrenomycetes, with numerous new species and also many new genera, occupies the first 114 pages. Then follow the Fungi imperfecti—Sphærospideæ and Hyphomycetes, also with very detailed descriptions of species already known, as well as many new to science, both genera and species in the different groups; the last to be described is *Verticillium cercospora*, a parasite on *Cercospora* sp. on the living leaves of *Solanum nigrum*, and also found on *Cercospora hibisca* on the living leaves of *Hibiscus esculentus*. A. L. S.

Hungarian Fungi.—G. MOESZ ("Mykológiai Közlemenyek. VIII," *Bot. Közlem.*, 1931, 28, 161-74, 11 text-figs.). Moesz contributes a series of fungi belonging to the Sphærospideæ group. Many of them are new species, others are new combinations. Diagnosis, habitat, etc., are in Latin. A. L. S.

Study of Apple Cankers.—NELLIE A. BROWN ("Some Pathological Studies on Apple Cankers," *Phytopathology*, 1932, 22, 397-414). Perennial canker of apple trees has long been known, and as various fungi and bacteria have been associated with the cankered tissues, the trouble has been assumed to be caused by some fungal organism. The writer has carried out a thorough research of the subject—by study of the cankers themselves, by infection experiments, etc. She has concluded that the fungus *Glaeosporium perennans* most frequently found in cankers is not the cause of the trouble and has judged that the deformations are due to winter injury, probably with woolly aphis as a secondary factor; winter-injured tissues are known to be a good medium for the growth of fungi which are not primarily parasitic. Research was carried out by cultures and by collating evidence of the incidence or absence of canker formations, according to the state of winter cold. A. L. S.

Study of *Phymatotrichum*.—J. J. TAUBENHAUS and WALTER N. EZEKIEL ("Resistance of Monocotyledons to *Phymatotrichum* Root Rot," *Phytopathology*, 1932, 22, 443-52, 1 text-fig.). The fungus *Phymatotrichum omnivorum* attacks the roots of many plants. It was found advisable to test the susceptibility of Monocotyledons to the parasite as it had been reported to cause disease of grasses, etc., in Arizona. The writers of the paper grew sixteen kinds of Monocotyledons alongside of plants such as cotton, carrot, etc., all highly inoculated with the fungus. None of the Monocotyledons were affected, while the other plants succumbed to the disease; it is therefore concluded that it is safe to grow Monocotyledons on infected soil.

A. L. S.

Resistance of Malvaceæ to Root Rot.—WALTER J. BACH and J. J. TAUBENHAUS ("Resistance of the Turk's-Cap *Hibiscus*, *Malaviscus Conzatti*, to *Phymatotrichum* Root Rot," *tom. cit.*, 453-58, 1 text-fig.). A study was made of the Turk's-Cap *Hibiscus* because it is the only malvaceous plant that is immune to *Phymatotrichum* root rot. Eighty-two species of plants belonging to the Malvaceæ have been tested and their susceptibility to root rot has been proved. With similar tests the Turk's-Cap was uninfected. When shoots of the plant were planted in infected soil some of them took the disease, but eventually they threw off the affected roots and developed others. Further study of the factors and nature of the resistance is in progress.

A. L. S.

Further Study of Root Rot.—WALTER N. EZEKIEL, J. J. TAUBENHAUS, and J. F. FUDGE ("Growth of *Phymatotrichum omnivorum* in Plant Juices as Correlated with Resistance of Plants to Root Rot," *tom. cit.*, 459-74). Cultures were made of the fungus in media prepared from plant juices extracted from susceptible and non-susceptible plants, and were grown side by side. After a given time the resultant mycelial growth was weighed and the results tabulated. Comparisons were made between different juice cultures, and between diluted and undiluted juices. It was found that in undiluted juices of resistant plants growth was markedly inhibited, and heavy growth was obtained from juices of susceptible plants. With diluted juices good growth was obtained even in series from resistant plants. It is considered to be proved that Monocotyledons contain substances that inhibit the root rot in high concentrations. Further study is in progress to determine the nature of these juice materials.

A. L. S.

Lichens.

Lecanora subfusca and Allied Species.—A. H. MAGNUSSON ("Beitrage zur Systematik der Flechtengruppe *Lecanora subfusca*," *Göteborgs Bot. Trädg.*, 1932, 7, 65-87). Magnusson has selected this group of lichens for special study as opinions have differed as to the status, whether species, variety or form, of many of the lichens cited. *Lecanora subfuscus* (L.) is a widespread lichen and Magnusson has decided that the original diagnosis is not sufficiently defined, so he has substituted *L. subfuscata* Magn. with a new diagnosis. He has to some extent rearranged varieties and forms, giving them specific status, and has added descriptions of special characters, such as the condition of the apothecial margin and the occurrence or absence of crystals in the epithecium (inspersed or non-inspersed). A synoptic key of these allied species is provided. Not all of them are European.

A. L. S.

Kerguelen Lichens.—BOULY DE LESDAIN ("Lichens recueillis en 1930 dans les îles Kerguelen, Saint-Paul et Amsterdam par M. Aubert de la Rue," *Ann.*

Crypt. Exot., 1931, 4, 98-103). Collectors of lichens and other plants are frequently attracted to isolated islands such as Kerguelen. Bouly de Lesdain has given lists and descriptions of the most recent collections there. Twenty-five genera are represented; nine species are new to science. Kerguelen supplied the large majority of species which with few exceptions were found on rocks or stones.

A. L. S.

Forest Lichens.—A. H. BRINKMAN ("Lichens in Relation to Forest Site Values," *Bryologist*, 1932, 34, 66-71). The object of the work recorded was to find out if lichens occurring in forests have any significance as to "site values." The writer has concluded that the types of lichens do vary with the soil value, though the influence of habitat, with difference in altitude and in geographical position, must also be taken into account. The lichens given in the list were all found within the forest area. The general conclusion was that the types, especially of soil lichens, indicated the value of the land: thus soil *Cladonia* were found on the poorer sites, but those on logs occurred in the better types of land, mainly peopled with Pine timber.

A. L. S.

Russian Lichens.—C. LADYSHENSKAJA ("Oekologisches Verzeichniss der Flechten in der Umgebung der Stadt Kologriv," *J. Soc. Bot. Russie*, 1931, 16, 544-53, 2 text-figs.). Russian with German summary. A list of lichens from Gouv. Kostromo—fifty-four species, four forms, and six varieties with ecological notes. All the lichens collected were new to the district; a great variety of families and genera are represented, the most numerous the *Cladonia* with sixteen species.

A. L. S.

Hungarian Lichens.—F. FÓRISS ("Heves Község zsmói—Die Flechten der Gemeinde Heves," *Bot. Közlem.*, 1931, 28, 180-82). Fóriiss has given a list of eighty-four lichen species, many of them from a wood with 200-300-year-old oaks. He notes the influence of weather conditions on the growth and fructification of species such as *Caloplaca cerina*, *C. gilva*, and others.

A. L. S.

Swedish Lichens.—GUNNAR NILSSON DEGELIUS ("Lichenologiska bidrg. IV," *Bot. Not.*, 1932, 278-94, 2 text-figs. Swedish with German résumé). The author records the finding of *Parmelia revoluta* in Sweden. It is one of the Atlantic species and is new to Scandinavia. He also found *Gyrophora murina* and gives his reason for rejecting the name *G. grisea*. It grows in south-eastern districts. A robust specimen of *Siphula ceratites* occurred in the extreme north to which was given the name *f. crassa*.

A. L. S.

Lichens of the Ægæan.—M. SERVIT ("Bearbeitung der von K. H. Reehinger (fil.) im Jahre 1927 auf dem Ägäischen Inseln gesammelten Flechten," *Ann. Naturhist. Mus. Wien*, 1931, 46, 77-90, 1 text-fig.). The collector, K. H. Reehinger, worked over six islands and found a very varied series of lichens due to the differences in soils and surroundings. A new genus, *Reehingeria*, was discovered, with blue-green gonidia and near to the genus *Thyrea* but with compound apothecia up to 2 mm. in width. A new species of *Pertusaria* is also described. The lichens grew mainly on rocks or soil.

A. L. S.

Lichen Studies.—V. GYELNIK ("Nephromæ novæ et critica," *Ann. Crypt. Exot.*, 1931, 4, 121-48). Gyelnik announces this paper as a forerunner of work to be published. The species here discussed are mainly exotic—forty-five species in all. He has diagnosed many new species and varieties or forms. In his determinations he makes use of chemical characters and of the presence or absence of isidia either as specific or as isidial characters.

A. L. S.

Ramalinæ duæ novæ e Paraguay.—V. GYELNIK (*tom. cit.*, 150-1). The first species, *Ramalina Anisitisiana*, was collected by D. Anisits; it differs from *R. fraxina* in the reaction $K + \text{flavus}$. The second, *R. paraguayensis*, differs in several characters from other species—in the anatomy of the cortex and in the presence of papillæ that become sorediate. A. L. S.

Extra-European Lichens.—V. GYELNIK ("Additamenta ad cognitionem lichenum extra-europæorum," *tom. cit.*, 166-74). Many of the species, varieties or forms are described as new to science, and many are new to countries other than European, a large proportion being from America. A. L. S.

Crimean Lichens.—W. K. TSHERNOV ("Ueber die Verteilung der Flechten im Krimgeborge," *J. Soc. Bot. Russie*, 1931, 16. 536-43). The short summary in German gives the leading characteristics of the Crimean lichen flora, especially of the mountain regions. (1) In alpine regions there is an abundance of crustaceous forms, on stones, rocks, etc. Among the most frequent are *Placodium aurantiacum* and *Verrucaria marmorea* along with species of *Lecanora* and *Aspicilia*. (2) On volcanic rocks—*Placodium elegans*, *Lecanora atra*, *L. badia*, *Parmelia cylisophora*, *Rhizocarpon geographicum*, etc. (3) The lichens of leafy trees—species of *Lecanora*, *Physcia*, *Parmelia*, *Ramalina*, etc. (4) The species on limestone and slate in the southern regions, with those on various trees, are a numerous and varied series: the most abundant in the *Pinus Laricio* zone being *Evernia furfuracea*. The lichens on walls, on wood, stumps of trees, etc., are also recorded from the region. A. L. S.

Lichens of Volcanic Rocks.—M. et MME. FERNAND MOREAU ("Sur le peuplement de cheires volcaniques d'Auvergne," *Bull. Soc. Bot. France*, 1932, 79, 5-10). The term "cheires" is used for the narrow streams of lava that now occupy the valleys of Auvergne and have a rough, stony surface contrasting with the sides of the valley which are covered with vegetation. Several of these "cheires" were examined by the authors. The principal growth found on them is a somewhat poor development of the crustaceous lichens present, twenty-one species of which were determined, with one alga, *Trentepohlia aurea*, and a shrubby lichen, *Ramalina polymorpha*. On the stone walls built of volcanic rock the lichen vegetation was continuous, while on the "cheires" they grew as scattered patches or fragments of the plants. The authors traced the denudation of the areas to the action of the wind and to the presence of mosses such as *Rhacomitrium lanuginosum* which displace the lichen vegetation. Where a surface of soil had been established several of the larger lichens, *Peltigera* and *Cladonia*, had gained a footing, along with some of the higher plants which are enumerated—first herbaceous and then shrubby and arborescent. A. L. S.

Lichens of Monts-Dore.—M. et MME. FERNAND MOREAU ("Observations sur les Lichens d'altitude dans la région méridionale des Monts-Dore," *tom. cit.*, 44-61). The writers refer to their previous paper on the lichens of the Monts-Dore. The present work deals with the higher reaches—the alpine districts of these mountainous regions which are covered with snow for about six months of the year, and subject to heavy rainfalls and thick mists. The lichens found are enumerated in systematic order, their locality and frequency being indicated. It is pointed out that a number of the species also occur at the lower altitudes, though most of them are mountainous; also that a series of lichens, corticolous at the lower altitudes, grow on rocks in the uplands. The influence of high winds and severe falls of rain on the type of lichen is pointed out: only those of crustaceous

or minutely leafy form and of rapid growth are able to survive. Of these the most typical are *Parmelia stygia* and *Xanthoria lychnea*; others more or less abundant are *Parmelia corniculata*, *P. encausta*, and *Gyrophora cylindrica*. Some rocks are too exposed for any vegetation except traces of lichens. Certain species, robust but pliable, are able to resist the mechanical action of the high winds, and their generally more rapid growth also allows of reparation after the storms. The most important and favourable condition is the high and constant intensity of moisture due to the mists, to the influence of which can be traced the almost continuous growth of lichens on all these mountains. A. L. S.

Northern Lichens.—BERNT LYNGE ("The Godthab Expedition, 1928. The Lichens," *Medd. om Grønland*, 1928, 82, no. 3, 1-8). The lichens enumerated were collected by the Danish botanist Gunnar Seidenfaden in N. Greenland and in Baffin's Bay. Lynge calls special attention to the distribution of *Dufourea ramulosa* and *Dactylina arctica*; they are found in N. and N.W. Greenland, the latter has never been collected in E. Greenland. *Dufourea ramulosa* also is confined to the west and north. *Cladonia mitis* was the only one of the *sylvatica* group that was brought back by the Expedition. A. L. S.

Rhizocarpon in Fennia.—BERNT LYNGE (*Rhizocarpon nitidum* n.sp., *Mem. Soc. Fauna et Flora Fenn.*, 1931, 7, 145-6, 1 text-fig.). The lichen belongs to the *Catocarpus* group with two-celled spores. The medulla stains blue with iodine, blood-red with potash. It was collected in Fennia. A. L. S.

Rhizocarpon in Greenland.—BERNT LYNGE ("A Revision of the Genus *Rhizocarpon* (Ram.) Th. Fr. in Greenland," *Skrifter om Svalbard og Ishavet*, no. 47, 1932, 1-30). Lynge has made a survey of the occurrence of *Rhizocarpon* species in the extreme north as evidenced by the result of numerous collections. He finds that the genus is better represented in the eastern Arctic than in the western. The species differ also very considerably; there are only six circumpolar species of *Rhizocarpon* so far known. He emphasizes also the fact that no flora of that region is a biological unit. He has listed seventeen species, but among these are included the Section *Catocarpus* with two-celled non-muriform spores. *Rhizocarpon geographicum* is one of the most widely distributed. A. L. S.

Greenland Lichens.—BERNT LYNGE ("Lichens from South-East Greenland collected in 1931 on Norwegian Expeditions," *Op. cit.*, no. 45, 1932, 1-15, 1 map). The results from two expeditions are given in this paper—seventy-one lichens in all. *Cladonia* are among the most numerous in this little-known region. A. L. S.

Morocco Lichens.—ROGER-GUY WERNER ("Aperçu floristique sur les Lichens du Maroc," *Recueil de Travaux Cryptogamiques dédiés à Louis Mangin*, 1931, 1-7). The author gives a bare list of the species collected from the littoral up to the arid mountain tracts of Morocco. He considers the endemic flora to be of about 10 p.c. of the whole. The least important are the tropical and subtropical forms. Lichens of temperate regions form the majority. The Mediterranean is represented by comparatively few species but by an abundance of growth. A. L. S.

Japanese Lichens.—YASUHIKO ASAHINA ("Japanese Lichens of Coniocarpineæ," *J. Jap. Bot.*, 1932, 8, 1-5, 10 text-figs.). Asahina's record includes fourteen species of Coniocarpineæ, the first concise contribution to a projected lichen-flora of Japan. Most of the species belong to the European flora, but several of them are new to Japanese flora. They are well illustrated. A. L. S.

Lichens from Patagonia.—MARIA CENGIA-SAMBO ("Licheni della Patagonia e di altre regioni dell'Argentina raccolti dai missionari Salesiani," *Contrib. sci. Miss. Salesiani del Beato Don Bosco*, 1930, 1-73, 9 pls., 7 text-figs., 2 maps). Cengia-Sambo gives a description of the territory in Patagonia where the collections were made by the resident missionaries. The influences of soil, climate, etc., are linked with the type of lichens to be found. On the north towards Buenos Aires some tropical species were collected; the area included the Rio Negro and Chulut lands.
A. L. S.

Cladonia Development.—E. NELLIE SAWYER ("Note on the Squamules of *Cladonia ochrochlora* var. *ceratodes*," *Proc. Brist. Nat. Soc.*, 1931, 7, 252-8, 2 pls.). Squamules are frequently developed on the podetium of *Cladonia ochrochlora* var. *ceratodes*; the primordium of these growths is a protuberance containing an accumulation of gonidia, it was noted that the squamules developed on well-lighted sides. The gradual development is described. When fully formed these squamules resemble those of the primary thallus.
A. L. S.

Lichen Development.—ROGER-GUY WERNER ("Histoire de la Synthèse Lichénique," *Mém. Soc. Sci. Nat. du Maroc.*, 1931, 27, 1-45, 5 pls.). Werner has divided his work on lichens into (1) history; (2) study of lichenization; and (3) general résumé and conclusions. He gives an account of the various opinions held by early writers, especially with regard to symbiosis. By cultures and other methods he has followed the association of fungus and alga throughout all stages, both in the homoiomerous and heteromerous lichens, giving the stages of growth and development in the different types—crustaceous, foliose and fruticose. He describes the lichen fungus in natural conditions as spreading over the substratum in search of the alga, surrounding it and, along with it, forming the thallus and so advancing to the formation of squamules or "leaves," or the elevation of growth to form the vertical stalks or branches; it is, he finds, the fungus that determines the thalline development.
A. L. S.

Soil Reaction and Lichen Distribution.—FRITZ MATTICK ("Bodenreaktion und Flechtenverbreitung," *Festschr. achtzigj. Geburtst. Oscar Drude, Beih. Bot. Centralbl.*, 1932, 49, 241-71). The paper opens with a general review as to the influence of acidity and alkalinity of the soil with regard to plant growth, and a description of the methods used in soil investigation, with special reference to spore-plants. The main part of the work deals with lichen vegetation of soil and rock. There are examined in turn limestone rocks along with alkaline soil, and silicate rocks with acid soil. Notes are given of the lichens special to the different types of substratum: thus several types of growth are recognized: those on the above substrata; those that grow best on neutral rocks or soil; those confined to narrow limits of pH soils, which are designated as "stenion," and those that are "euryion" with a wider limit of pH necessity. A record of lichens follows with their peculiarities: thus we get *Nephroma parile* designated as "azidophil-stenion," while *Peltigera aphthosa* is "azidophil-euryion." Finally, he has noted that most lichen species demand a strongly acid substratum, fewer an alkaline. Nitrogen also influences growth of certain lichens. Among families the azidophilous include Cladoniaceæ, Parmeliaceæ and Gyrophoraceæ, the basidiophilous, Collemaceæ, and Verrucariaceæ.
A. L. S.

Increase and Dispersion in Cladonia.—F. TOBLER ("Vermehrungsweise und Verbreitung bei *Cladonia*," *tom. cit.*, 482-94). Tobler comments on the ecological significance of lichens and their importance in peopling waste places

such as sand dunes, etc., where the lichen vegetation is dominant and may be largely composed of *Cladonia*. *Cladonia sylvatica* and its allies are world-wide and of great importance. In that group, forming huge swards, there is little fruit formation and reproduction is necessarily vegetative. Tobler therefore examines the possibilities of dispersal and finds that the thalline structure of the branching podetia is fragile when dry, their tips become interwoven, and the whole mass is easily reduced to fragments and carried away by any disturbance of animals or of weather, each little particle being able to reproduce the plant in favourable conditions. The ease of dispersion and of the renewed growth of thalline particles explains the continual reproduction and dispersion of the *Cladonia* of this group.

A. L. S.

Ecology of Rocky Coasts.—G. EINAR DU RIETZ ("Zur Vegetationsökologie der ostschwedischen Küstenfelsen," *tom. cit.*, 61–112, 3 pls.). Du Rietz gives in his introduction an explanation of the main ecological terminology used in the paper, and an account of his methods of approach to the problems dealt with, including the determination of acidity, alkalinity, moisture, etc. He has worked from the sea-shore backwards to the cliffs and finds his first lichen vegetation among the "Hygrohalophyten" forming in the first belt *Lichina* and *Verrucaria maura*, further inland *Caloplaca marina* and *Lecanora actophila* associations. The next in order is the *Lecanora atra*—*Rhizocarpon constrictum* Ass. occupying the higher moist rocks, and higher still a *Xanthoria-parietina*-*Anaptychia* federation which includes a series of other associations. In the cliff recesses near the sea, grasses and lichens form *Festuca rubra*—*Cladonia pyxidata* associations. Isolated rocks and higher cliffs have also their special floras and the flat rocks are well covered. Special reference is made to the coprophilous associations, some in strongly nitrophilous positions, others weaker, characterized by different lichens. Calicolous rocks bear also a specialized flora. A meagre outline of this extensive study has alone been possible.

A. L. S.

European Cœnogoniaceæ.—ALWIN SCHADE ("Die Verbreitung von *Racodium rupestre* Pers. und *Cœnogonium nigrum* (Huds.) Zahlbr. in Sachsen," *tom. cit.*, 421–37, 14 text-figs.). Schade has given a complete account of these two plants that are constantly found growing together and have frequently been confused with each other. There is no fructification known of either: the distinction lies in the algal constituent. For *Cœnogonium nigrum* the alga *Trentepohlia aurea* is the constant gonidium; for *Racodium rupestre*, *Cladophora* sp., though Schade rejects that alga, without, however, determining any other relationship. He has given the results of his study of many specimens of both lichens, their habitat and manner of growth, and describes the differences of structure between the two.

A. L. S.

Cephalodia Formation.—O. V. DARBISHIRE ("Weiteres über die Cephalodien von *Peltigera aphthosa* L.," *Ber. Deutsch. Bot. Ges.*, 1932, 50, 178–84, 1 pl.). This new work on *Peltigera aphthosa* was undertaken by Darbishire in order to demonstrate the process of cephalodia formation in that lichen. He describes the formation of the normal thallus with the production of hair-like hyphæ on the surface of the cuticle. On these hairs alight *Nostoc* cells, three to six at first, which are gradually surrounded by the hairs and excited to more intensive growth. At a later stage these "hairs" penetrate and surround the *Nostoc* group. New hyphæ arise from the thallus surface; the first hairs forming the stalk of the cephalodium, the latter serving to attach the new structure which takes on a wider expansion. The underlying thallus becomes somewhat disorganized owing to

the absence of light inducing a loss of gonidia below the new structure; the hyphæ, however, retain their vitality and remain in close relationship with the hyphæ of the cephalodium.
A. L. S.

Mycetozoa.

American Mycetozoa.—MORTON E. PECK and HENRY C. GILBERT ("Myxomycetes of North-Western Oregon," *Amer. J. Bot.*, 1932, **19**, 131-47, 3 pls.). The authors have been accumulating material during twenty years, but they do not claim that the list now published is complete. A total of 194 species has been listed from the collections of themselves and also from various authors. Thirty-six genera are enumerated, *Physarum* being represented by forty-three species. Ten new Mycetozoa have been described, and eight species are new to the American continent. Habitats, and seasonal appearance are significant and are given throughout the paper.
A. L. S.

Polish Mycetozoa.—J. JAROCKI ("Mycetozoa from the Czarnohora Mountains in the Polish Eastern Carpathians," *Bull. Acad. Pol. Sci. et Lettres, Cl. Sci. Math. et Nat.*, ser. B, 1931, **3**, 447-64). The author describes the territory examined—extensive spruce forests with numerous decaying stumps. He found in all sixty-nine species of Mycetozoa, fourteen of which are new to the Polish Republic. Several of them are rare and interesting; special descriptions are given of *Barbeyella minutissima* and of *Colloderma oculatum*. Jarocki has felt that the time given to his investigation was too short, and was limited to the periods of vacation, otherwise many more species might have been found. He has described a method for preserving æthalia in herbaria.
A. L. S.

Systematy of Mycetozoa.—G. W. MARTIN ("Systematic Position of the Slime Molds and its Bearing on the Classification of the Fungi," *Bot. Gaz.*, 1932, **93**, 421-35). In the discussion of his subject Martin has cited the work done on this group of organisms by systematists in the past, stating the many different views as to their origin and affinities. He himself is inclined to associate them with the fungi forming a natural class of Myxomycetes. He challenges also the assumption that all living organisms are descended from a single primitive cell, and denies the view that the plasmodium is merely the fusion of numerous myxamœbæ. It initiates usually by the fusion in pairs of swarm cells, with fusion of the nuclei, the diploid nucleus then divides and thus inaugurates the multi-nucleate condition of the plasmodium. He compares their structure and development with that of allied organisms and gives reasons for concluding that the Myxomycetes form a natural but distinct class of fungi, not so sharply separated from Phycomycetes as has been supposed. A long list of literature on the subject is cited.
A. L. S.

Plasmodium of Mycetozoa.—E. JAHN ("Die Organe des Plasmodiums. Myxomyceten-studien nr. 14," *Festschr. zur Feier des 50-jähr. Bestehens Deutsch. Bot. Ges.*, 1932, **50A**, 367-98, 13 text-figs.). Jahn begins by stating that the plasmodium of the Myxomycetes is not a primitive body: it is a highly organized adaptation of the vegetative body of the Mycetozoa. His study was confined mainly to the plasmodium of *Badhamia utricularis*. He describes the different substances—fungi, bacteria, plant-remains, etc., which serve as nourishment to the plasmodium, with its reaction to other materials. He then passes to the form and shape developed on the various substrata with its method of attacking these, and the formation of "veins." He has described in great detail the stream-

ing of the plasmodium substance and the causes that govern its behaviour: it begins mostly towards the edge. The front part takes in food, the second zone is the digestive area. Vacuoles are organs of excretion. Many other details and functions as shown in plasmodium cultures are described, the study of which originated with Lister's researches on Mycetozoa in 1888. A. L. S.

Study of Acrasieæ.—R. A. HARPER ("Organization and Light Relations in *Polysphondylium*," *Bull. Torrey Bot. Club.*, 1932, 59, 49–84). It has already been proved that *Dictyostelium* and *Polysphondylium* are positively phototropic as to the sorocarps which are formed of a swarm of units simulating the outward structure of other higher plants. The object of the paper is to determine the factors that induce the formation of these bodies which have reached a definite form and a fixity of type. It is evident that light is one of the influences at work. Culture experiments were made and the results with their significance are described. Finally, the author states that "the passing from one stage to another is visible integration, the expression of the inherited and spontaneous activities of the amœbæ limited and more or less directed by internal and external environmental stimuli." A. L. S.

NOTICES OF NEW BOOKS.

The Food of Protozoa.—By H. SANDON, M.A., Ph.D. 1932. (Publications of the Faculty of Science, Egyptian University, No. 1.) ii + 187 pp. Published by the Egyptian University. Price Piastres 20.

Microchemical Laboratory Manual.—By FRIEDRICH EMICH, Dr.Phil.H.C., Dr.Ing.E.H. With a Section on Spot Analysis, by Dr. FRITZ FEIGL. Translated by FRANK SCHNEIDER, Sc.M. 1932. xvi + 180 pp., 88 text-figs. Published by John Wiley & Sons, Inc., New York, U.S.A.; and Chapman & Hall, Ltd., 11, Henrietta Street, Covent Garden, London, W.C.2. Price 18s. 6d. net.

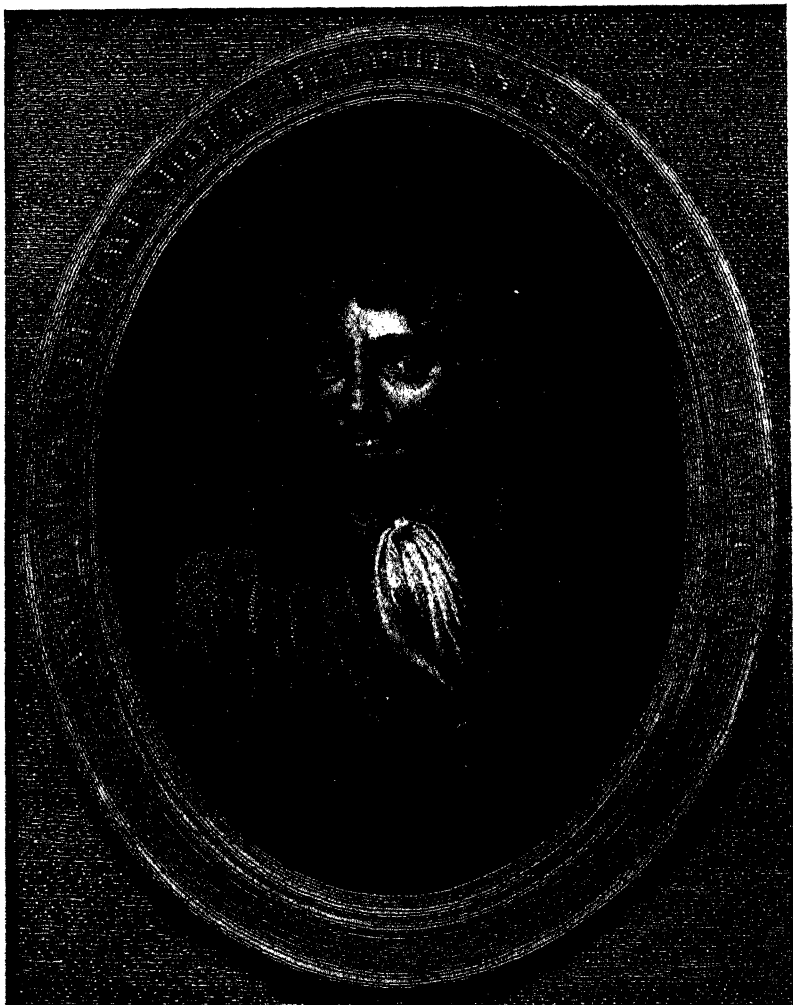
This translation of Emich's "Mikrochemisches Praktikum" will be very welcome in view of the increasing recognition of the value of microchemical methods in many fields of work. It is designed to serve as a text for a course of instruction, but it is written with such detail and clarity of expression that the chemist unable to attend a special course may nevertheless acquire a working knowledge of microchemical methods.

The book is divided into two main sections. The first part describes apparatus and general manipulative methods and includes a few pages on the microscopic examination of crystals. The second part provides a series of practical exercises in qualitative inorganic analysis, in the specific reactions of organic chemistry and the preparation of a number of organic substances, and in gravimetric analyses. A chapter by Feigl on specific microchemical tests by the "spot" method is included. The description of the methods dealing with small quantities of substances will be of particular value to students of biochemistry. As an example may be mentioned the preparation and recrystallization of acetanilide from 2 mg. of aniline. The book does not deal with the elementary analysis of organic substances but properly refers the student to the indispensable "Pregl." A useful feature of the work is the large number of references to special applications of microchemistry so that a knowledge of the literature is easily acquired. S. S.

Leitfaden der mikroskopisch-anatomischen Untersuchung pathologischer Objekte, des Blutes und des Zentralnervensystems. [Manual for the histological examination of pathological objects, blood and central nervous system.]—By G. C. VAN WALSEM. 1932. vi + 85 pp., 48 text-figs. Published by S. Hirzel, Leipzig. Price RM.4.

The contents of this small, paper-backed volume are amply summarized in the title. A somewhat elementary account is given of the lay-out of a histological laboratory and its equipment. The only references given are to German or Dutch publications. Many of the illustrations are poor and rather unnecessary, such as those of a hand centrifuge and a Bunsen burner.

G. M. F.



Engraved by J. Verelst.

Engraved by J. Verelst.

ANTONY VAN LEEUWENHOEK,

Born 1632.

Fellow of the Royal Society.

Died 1723.

JOURNAL OF THE ROYAL MICROSCOPICAL SOCIETY.

DECEMBER, 1932.

ANTONY VAN LEEUWENHOEK.

1632-1932.

THE tercentenary of the birth of Antony van Leeuwenhoek occurred on October 24th, 1932. He was born at Delft in Holland, and there he died on August 26th, 1723. Few men have done more for the science of microscopy, while both bacteriology and protozoology look to him as their founder. He it was who first discovered, described, and depicted protozoa in 1674; two years later he discovered bacteria, the first representations of which are to be seen in the Philosophical Transactions of the Royal Society of London, published in 1683.

Leeuwenhoek used single lens of very short focus which he ground himself, preferring them to the compound microscopes then in use. It is matter for deep regret that the Royal Microscopical Society does not possess an original example of his work in its collection of historical microscopical instruments. Of the numerous microscopes made by Leeuwenhoek, once in the possession of the Royal Society of London, all are now lost.

Leeuwenhoek's contributions to general biology are of epochal importance. He was the first to describe the red blood corpuscles, human spermatozoa, the structure of the teeth, the crystalline lens, and the essential differences in the structure of the stem in monocotyledons and dicotyledons.

An amateur in the true sense of the word, Antony van Leeuwenhoek remains a master of experimental science.

G. M. F.

TRANSACTIONS OF THE SOCIETY.

576. 3.

XVI.—MITOSIS IN *GALANTHUS NIVALIS*.*

(With special reference to chromosome structure, and the time at which splitting occurs.)

By KATHLEEN M. PERRY, B.Sc.

(From Cytological Laboratory, Dept. of Botany, University of London, King's College.)

(Read November 16th, 1932.)

TWO PLATES AND TWO TEXT-FIGURES.

I. INTRODUCTION.

In this cytological investigation of *Galanthus nivalis* it was primarily the intention to examine the meiotic chromosomes. Bulbs obtained from several sources and examined in mid-September, however, contained fully formed pollen in all their anthers—the reduction divisions must have occurred some time before. Therefore an examination of root-tips was undertaken, and the results of this investigation form the substance of the present paper. A second contribution recording the results afforded by an examination of the reduction divisions will be added as soon as the necessary material becomes available.

Svensson-Stenar (1925) showed that the haploid chromosome number for *G. nivalis* is 12. The diploid number was worked out by Heitz (1926) for *G. nivalis* and *G. Elwesii* and found to be 24 in each case. The morphology of the chromosomes was also shown, but nothing was added regarding their structure.

The diploid number is confirmed for *G. nivalis* in the present paper, and in general the shapes of the chromosomes figured by Heitz have been found, a considerable range in size in the chromosome set being an interesting feature. The individuals are recognizable by the position of the attachment constriction determining their shape, but no characteristics such as trabants have been observed.

* Thesis approved for the degree of Master of Science in the University of London.

II. MATERIAL AND METHOD.

Bulbs were grown in damp silver sand at room temperature. In 5 or 7 days collections were made as the roots reached a length of 4 mm. to 8 mm. The time of collection was varied from 9.30 a.m. to 1 p.m., but, on examination of the root-tips, all stages from resting nuclei right through to interphase were generally shown by material collected at any of these times.

The delicate roots were cut off with a pair of small, very sharp dissecting scissors, the sand first being brushed from them very carefully by means of a camel-hair brush. After fixation, the sand which still adhered was removed by continuous washing.

In all cases the roots were plunged into the fixative immediately they were severed from the bulb and an exhaust pump was used to ensure that they sank rapidly in the fluid.

Various fixing agents were used with different degrees of success, the fixatives employed being :

1. *Bowin's Fluid*.

Commercial formalin, 25 c.c.

Picric acid sat. aqueous, 75 c.c.

Glacial acetic acid, 5 c.c.

Used both cold and warmed to a temperature of 38° C.

Time for fixation, 6-8 hours.

2. *Allen's Modification of Bowin's Fluid*.

Bowin's Fluid heated to 38° C., then 2 gms. urea and 1.5 gms. chromic acid added immediately before use.

Time for fixation not more than 1 hour, as the chromic acid tends to oxidize rapidly and the material deteriorates.

3. *Bowin's Fluid* used warm, with urea as for Allen's modification, but without chromic acid.

Time for fixation, 1-2 hours.

4. *Flemming's Fluid*.

1 per cent. chromic acid, 45 c.c. } A.
Glacial acetic acid, 8 c.c. }

2 per cent. osmic acid, 12 c.c. B.

A and B mixed as required for use.

Time for fixation, 24 hours.

5. *Modification of Flemming's Fluid*.

1 per cent. chromic acid, 60 c.c.

2 per cent. osmic acid, 20 c.c.

5 per cent. acetic acid, 25 c.c.

Time for fixation, 24 hours.

6. *Carnoy's Fluid.*

Absolute alcohol, 6 parts.

Chloroform, 8 parts.

Glacial acetic acid, 1 part.

Material immersed for 1 minute, then transferred to

Navashin's Fluid.

1 per cent. chromic acid, 10 c.c.

Glacial acetic acid, 1 c.c.

Commercial formalin, 4 c.c.

Time for fixation, 3 hours. Transfer material directly to 30 per cent. alcohol.

In general, the best results were obtained by using fixatives 4, 5, and 6 in the above list.

Both longitudinal and transverse sections were cut at thicknesses ranging between 2μ and 40μ .

The stains employed were Haidenhain's hæmatoxylin and iron alum, Newton's gentian violet and iodine combination, Flemming's triple, and several experimental combinations of erythrosin with cyanin blue, and with iodine green. By far the best results were obtained with the gentian-violet-iodine technique, especially when applied to material which had been fixed in one of the osmic acid mixtures. Owing to its transparency, this stain was particularly useful in dealing with the very thick sections necessary for giving a complete set of whole chromosomes in polar view at metaphase.

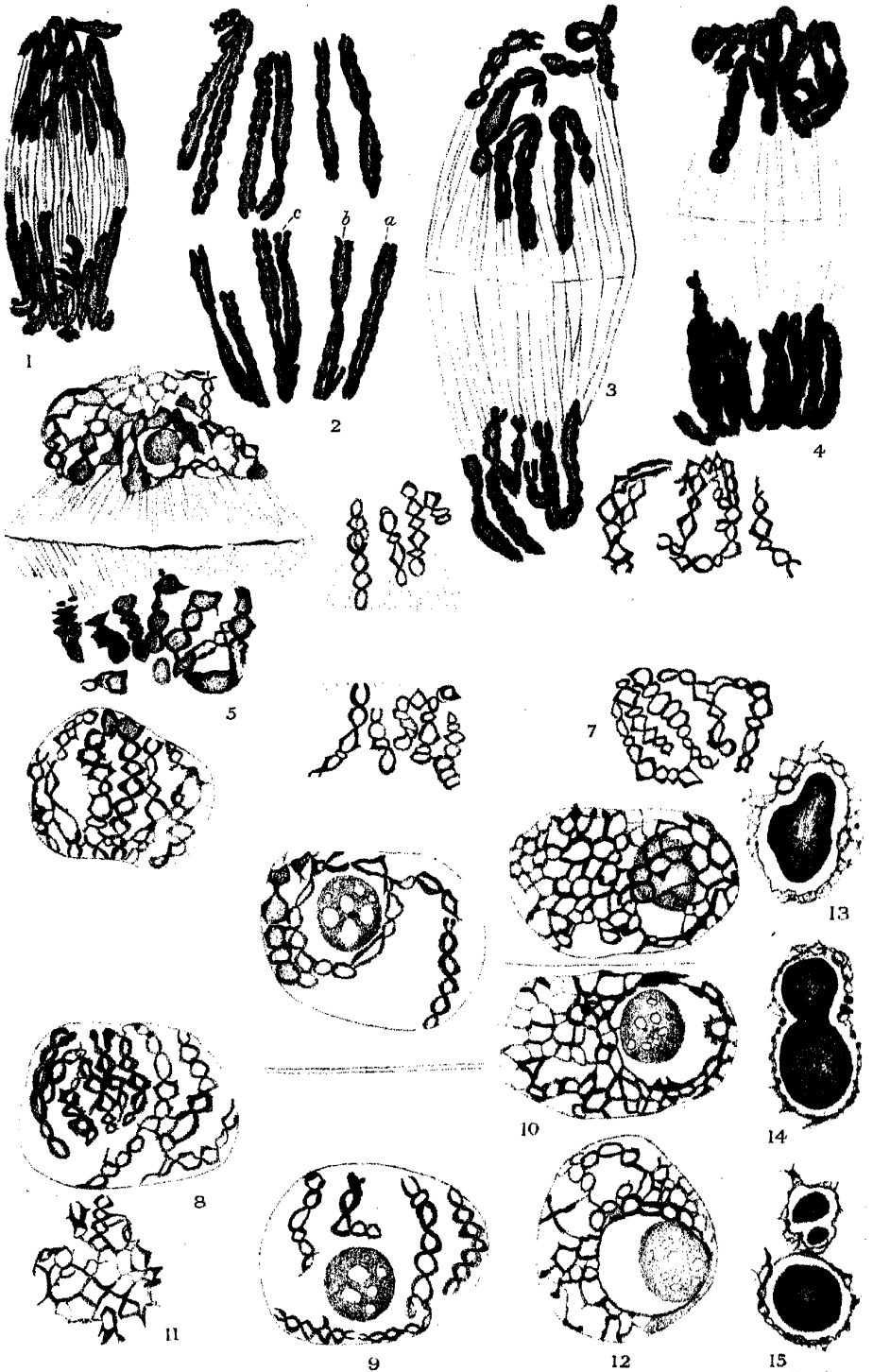
III. OBSERVATIONS.

The anaphase is described first, since, in common with many investigators, it is deemed simpler to begin with a stage in which the chromosomes are definite units, and thus avoid a break in the description at the more critical (from the point of view of chromosome structure) telophase, resting, and prophase stages.

1. *Anaphase.*—From the time the chromosomes pass on to the spindle, until they are entering telophase, they have a very great affinity for all chromatic stains. This is due to the fact that the matrix in which the two chromonemata are imbedded stains far more deeply at this stage than at any other, thus obscuring the chromosome structure in most preparations. It has been found possible, however, by a longer destaining process than is usually necessary, to elucidate the constitution here, and in such favourable preparations it is quite obvious that the chromosomes at this stage possess a double structure (pl. I, figs. 1–4). This duality is due to the presence of two chromatic threads or chromonemata, which are frequently twisted about one another, and between them is the less chromatic matrix. In some cases along part of their length the chromonemata show a granular appearance which cannot be attributed entirely to twisting (pl. I, fig. 2).

1. 2.

3. 4.



The twists become more numerous as the chromosomes reach the poles, and, arrived there, they clump together, so that their individuality is almost lost to view, except in very much destained preparations (pl. I, fig. 4). The chromosome group at this clumped, or "tassement polaire," stage occupies far less space than at the telophase which immediately follows it (*cf.* pl. I, figs. 4 and 5). This stage is perhaps the most difficult for observation, since the doubleness—of which I have no doubt—is so frequently obscured by bad fixation or staining, or a combination of both. A further difficulty arises where large magnifications are used—the light region observed between the two chromonemata is frequently referred to as a refraction phenomenon. This would be a very possible source of error, if conclusions were drawn from chromosomes such as that shown at fig. 2, *a*, alone; but where twisting of the chromonemata (as pl. I, fig. 2, *b*) and bifid ends of the chromosomes (as pl. I, fig. 2, *c*) are also seen, it must be concluded that there really is a duality in the chromosome.

2. *Telophase*.—After the clumping which completes anaphase, and the consequent indistinctness that accompanies such a condition, the telophase figure again shows clearly how the chromonemata are behaving (pl. I, figs. 5–10). The chromosomes gradually move apart from one another and the chromosome matrix apparently disappears; at all events, no definite achromatic portion can be observed to belong to any one pair of chromonemata at this stage. It seems probable that the matrix may be partly absorbed into the karyolymph, or—in view of the relations between matrix and nucleolus during prophase—it is possible that it may have some connection with the reconstitution of the latter. Without observations of this stage on living material, it is impossible to say exactly what happens to the achromatic substance, but certainly it cannot be seen to exist in individual portions corresponding to the chromosomes, part of which it constituted during late prophase, metaphase, and anaphase. If, as seems probable then, the achromatic portion of the late anaphase chromosomes (which has completely lost its staining capacity) becomes intermingled with the karyolymph of the telophase nucleus, we must conclude that chromosome individuality is not wholly preserved through the resting stage, but that it is only carried through by the pair of chromonemata which form the rudiments of the next generation of chromosomes, collecting a fresh achromatic ground substance during the next prophase.

Representing each chromosome, then, is a pair of chromonemata between which is only unstained material. The threads are twisted spirally about one another and the chromosomes are consequently somewhat shorter than the corresponding anaphase chromosomes. As the chromosomes move apart it is seen that they do not become entirely free from one another, but that anastomoses connect them at certain points. It is also further obvious that anastomoses are put out between certain chromosomes which were not in contact during the clumped stage. This process of extensive anastomosing results in the nuclear contents adopting rather a lattice-like appearance,

forming a regular reticulum in which the pairs of threads are quite clearly visible (pl. I, figs. 11 and 12).

A nuclear membrane becomes reconstituted around this telophase figure—no chromosome membranes were observed in earlier stages, so I can venture no conclusions regarding the suggestion that these take part in forming the nuclear membrane of the resting nucleus; but this is an interesting idea which merits further investigation, especially in view of its bearing on chromosome individuality. Meanwhile a nucleolus has become reconstituted and is imbedded among the chromatic network. On its first appearance the nucleolus is small (pl. I, fig. 5), but it rapidly assumes its normal proportions. Unfortunately, no indication is found of the way in which it arises, but it seems highly probable that its reappearance has some connection with the disappearance of the achromatic chromosome constituent, and I am inclined to believe that it is of the nature of a reservoir for some part of this substance.

At very early telophase, as the matrix disappears it begins to do so from between some of the meshes formed by the chromonemata before others. This gives a somewhat alveolar appearance and may account for certain of the observations made at this stage attributing the origin of doubleness to alveolation (pl. I, fig. 5). That the chromosomes are already double in anaphase, however, now seems a well-established fact, and from my observations I am inclined to contend that the so-called alveolation is an artifact.

3. *Resting nucleus*.—Further anastomosing between the telophase chromosomes gives the resting condition, considerable increase in the size of the nucleus usually occurring at this time; there is, however, considerable variation in size between resting nuclei in the same root-tip. Generally those nearer the epidermis are smaller than those deeper in the root, and frequently the nuclei in a few cell layers right at the centre are considerably elongated in the direction of the root-axis, following the elongated shape of the cells in which they occur.

The resting nucleus contains, inside the delicate membrane, a fine reticulate network of deeply staining threads, formed from the telophase anastomoses, and, usually containing granules which stain even more deeply and are particularly noticeable where the threads cross to form the meshes. Sometimes this delicate reticulum is interrupted by a coarser portion—a very thick thread, or an extra large granule, may occur. Very occasionally an indication of the duality of the threads has persisted from telophase; the achromatic matrix still remains invisible (pl. II, figs. 16–18).

In the resting nucleus there may be one nucleolus, but frequently there are two, and occasionally three or four; in no case has any structural or staining difference been observed between nucleoli in the same nucleus. Frequently, however, there is a difference in size (pl. I, fig. 15, and pl. II, fig. 17); usually where there are more than two nucleoli one is large and the remainder very small. It is believed that the single nucleolus formed at telophase gives rise to others by a process of “budding,” since some resting

nuclei show a single nucleolus rather drawn out, with a constriction about the centre (pl. I, figs. 13 and 14).

The nucleoli in the resting nuclei are spherical or oval, with Flemming's fixative they show no internal differentiation, but take the stain uniformly and slightly less densely than the chromatic reticulum (pl. I, fig. 15); with Navashin's fluid, however, the nucleoli are seen to have a coarsely alveolar structure and under high magnification it is seen that, between the larger vacuoles there are smaller ones, the whole giving rather a frothy appearance (e.g. pl. II, fig. 19). Large refractive granules are frequently present in the nucleolus; these are particularly common in sub-epidermal layers of the root.

4. *Prophase*.—Gradually the resting nuclear reticulum begins to pass through a series of changes as the chromosomes are differentiated as a preliminary to their arrangement on the metaphase plate. The fine threads of the reticulum become progressively thicker and the fact of their occurrence in pairs becomes more and more obvious until finally the duality can be traced throughout the nucleus (pl. II, fig. 19). Meanwhile the granules observed throughout the resting condition become more numerous. The resulting threads have a continuously coarse granular appearance, giving the familiar chromomere stage. The portions of the thread between the granules continue to stain less deeply than the granules themselves (pl. II, fig. 21).

Since the threads occur throughout in pairs, the chromomeres occur in double rows; and although the opposite members are identical in size, there is considerable variation in the size of adjacent chromomeres in any one row. These chains of granules do not always remain in two exactly parallel rows, but often show twisting about one another, this rather spirally twisted effect becoming more marked as prophase proceeds. Since this stage showing double threads with granules regularly distributed throughout their length is not very frequently found, it is assumed that this is a stage which is rapidly passed over, and that soon, as the threads contract in length, the chromomeres are brought more closely together until they finally coalesce; the thread then gives a uniformly stained appearance (pl. II, fig. 22).

Within the nuclear membrane, then, there is a collection of double threads—much heavier than the threads of the resting reticulum—and as the stage proceeds the achromatic substance, which has not been obvious as such since the beginning of the last telophase, again appears between them (pl. II, figs. 23 and 24). As these changes from regular reticulum to paired threads are proceeding, the nucleolus is also undergoing marked alteration. The alveolation partly disappears, the nucleolus becoming more deeply stained, and the refractive granules are no longer visible. This may be due to their absorption into the changing substance of the nucleolus, causing it to stain more deeply.

The spherical shape of the nucleolus is now lost, it becomes irregular in shape and rather granular in consistency. It gradually shrinks and a

darkly staining periphery is noticeable; from peaks on its surface, threads connect with the double chromatic threads (pl. II, figs. 20-22). This connection, and the diminution in size of the nucleolus, suggests that there is a flowing-out of nucleolar material into these threads which are in the process of chromosome formation; and it is believed that the matrix between the pairs of chromonemata may be the part most intimately concerned with this flow of nucleolar material. This view is further strengthened by the manner of reappearance of the nucleolus at telophase, as already described. It is unfortunate that no stage at telophase which could be said to represent a flowing-back of material to form a nucleolus has been observed; and it would be impossible to form too definite an opinion without this evidence. Further, before too conclusive a result can be given, direct chemical work needs to be carried out on the constituents of both nucleolus and chromosomes.

The threads thus formed at prophase are frequently twisted about one another as were the finer ones from which they were made. They are very long, often several times the diameter of the nucleus, and wound closely around inside the membrane. A count of the free ends shows that the threads are approximately equal in number to the number of chromosomes (24) seen at metaphase. As these thick threads are first formed by the coalescing of the chromomeres they show a variation in thickness throughout their length, the broader portions doubtless corresponding to the positions of the original chromomeres; but gradually the differences disappear as the threads contract still further, and late prophase shows twenty-four bodies, each consisting of two rather thick chromonemata containing the partly stained matrix between them.

5. *Metaphase*.—As late prophase merges into metaphase the nuclear membrane disappears and the double threads which are twisted about one another gradually become thicker and thicker (pl. II, fig. 25). Their staining capacity increases and they preserve a constant thickness; by still further contraction they now assume the typical form of metaphase chromosomes, becoming arranged on the equatorial plate, the spindle fibres becoming differentiated around them.

There are twenty-four chromosomes, twelve of which can be seen to differ from one another in size, and in shape due to the position of the attachment constriction, the other twelve corresponding to these (text-fig. 2). In all, then, twelve pairs of chromosomes are recognizable, and in a polar view of the metaphase plate these can be seen to be arranged in a definite fashion (text-fig. 1).

Each chromosome is quite clearly double at this early metaphase stage, the two halves which represent the daughter chromosomes being tightly twisted about one another (pl. II, figs. 26 and 27). Gradually they become less tightly coiled, and at about this time the first evidence that each daughter chromosome is itself double, becomes visible (pl. II, figs. 27, 28, and 30). It is very difficult to decide at exactly what stage in the division splitting occurs, but no evidence is found of a quadripartite structure before very

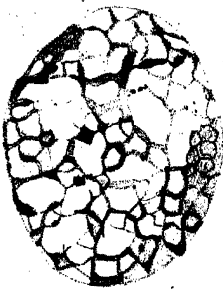
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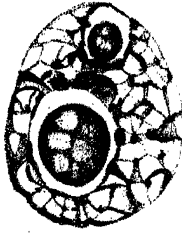
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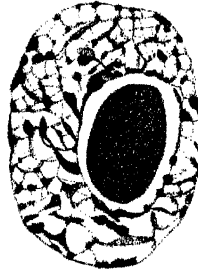
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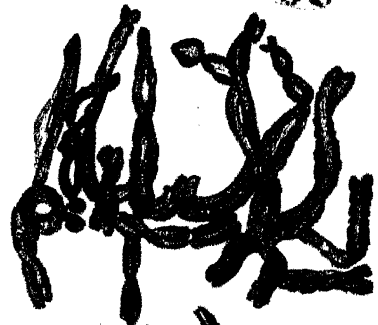
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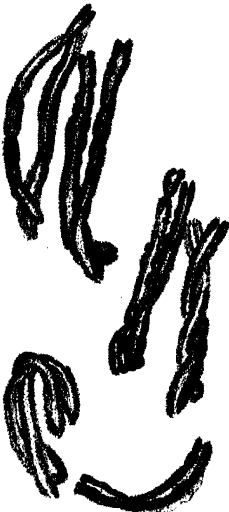
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late prophase or metaphase. It is therefore assumed that at this stage each of the two threads becomes duplicated, so that, for a short time, each body in the nucleus shows four strands, obviously occurring in two pairs—the pairs being spirally twisted about one another, but the two constituent threads of each pair lying side by side without twisting.

The division of the chromonemata for separation at the succeeding

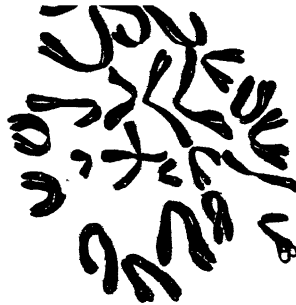


FIG. 1.

anaphase has thus occurred before the two new chromosomes have parted in the previous anaphase. It is important to note that this division is of the chromonemata, and not of the chromosome; the achromatic part of the latter does not divide until the anaphase at which the two parts will separate.

Gradually now the sister chromosomes are pulled apart, probably by the tension of the spindle fibres. Usually further loosening of the twists occurs



FIG. 2.

before the chromosomes separate. Sometimes they part first in the middle whilst the ends are still in contact, while, at others, one end is divided before the rest of the chromosome; this depends upon the point of attachment of the spindle fibre.

The chromosome structure described at the beginning for anaphase is thus, once again, obtained, the doubleness having been provided by the division of each of the chromonemata probably at late prophase.

IV. DISCUSSION.

An investigation of this kind naturally involves several fundamental questions of cytological importance, and in view of the large amount of

contemporary literature on these subjects, and the extensive bibliographies which have recently been published, it is not proposed to dwell at length here on the various theories of chromosome structure, the position and method of splitting of chromosomes, etc., but rather to mention briefly the more recent advances along each of these lines where they appear to bear directly upon the observations detailed above; and to make some attempt at fitting in these observations to one or other theory.

Theories of chromosome structure are naturally closely related with theories and observations regarding the method and position of their splitting, so it might be advantageous to consider the former and, having formed some conclusions from these observations on *Galanthus nivalis*, to pass on to the latter.

There are three main theories of chromosome structure, which will only be very briefly described. Firstly, the alveolation theory, upheld by Grégoire (1906), Lawson (1912), Overton (1922), and Lee (1920, 1924). These investigators believe that the chromatic substance exists as a single continuous filament only at prophase. At other stages, although it may have the appearance of continuous, rather contorted threads, this is only due to the random arrangement of alveoles which happen to give this appearance. Secondly, the idea originated by Pfitzner (1882), and now the chromomere theory supported, for example, by Sands (1923, 1925) and Belling (1928), that imbedded in the achromatic matrix are chromatic granules or chromomeres in definite linear succession, probably each consisting of many more minute granules. Thirdly, the chromonema or spiral theory, suggested by the work of Baranetzky (1880) and Janssens (1901), and now held by many authors, among whom are Bonnevie (1908, 1911), Vejdovsky (1926/27), Sharp (1929), Kaufmann (1926), and Telezinsky (1930/1931). Essentially this involves the idea that the chromatic substance exists in the chromosome as a continuous, often spirally twisted, thread imbedded in an achromatic (or sometimes a less chromatic) matrix; the latter is not necessarily continuous from one generation to the next, but the filaments persist throughout the mitotic cycle.

It has been impossible—in describing my observations—not to use terms involving the acceptance of one or other of these theories; and it seems from the series of events observed in *G. nivalis* that the third of the possibilities mentioned above is the most easily acceptable, but some modifications are necessary.

Thus, I find a *pair* of chromonemata from the very beginning of chromosome differentiation. This is compatible with the observations of Dehorne (1911), Brunelli (1911), Kaufmann (1926), Vejdovsky (1926/27), Telezinsky (1930/31), and the later work of Sharp (1929). I do not, however, exclude the possibility of the chromomere hypothesis. By all reasoning on genetical lines it is obvious that the constituent parts of the chromosome must have some definite linear arrangement which will persist from generation to generation, and in view of the observed granular threads of prophase, and

occasionally also at later stages, I believe that, although often obscured by the proximity of the chromomeres, the chromonemata are linear aggregations of such granules, the latter being obvious only at certain times.

The chromatic portion of the chromosome is believed, then, to exist as a pair of spirally twisted chromonemata between which is an achromatic matrix. In my figures I have shown that this matrix is not so much a mould which limits the chromosome and determines its shape, but rather a somewhat fluid substance held between the turns of the spiral chromonemata.

Kaufmann (1926^b, p. 358) writes: "The chromatic material exists as a pair of chromonemata imbedded in an achromatic matrix which limits the chromosome and forms the material of the constriction zones." I frequently find, however, that the matrix does not appear at the constriction zones.

Sharp and others figure the matrix as providing the material of these zones, the chromosomes thus preserving a constant thickness. This is, however, a point of minor importance compared with the main point at issue—the confirmation of the chromonema hypothesis for yet another plant.

Concerning the fate of the matrix at each telophase I have little to add. It is probable that the more chromatic part may be absorbed into the nucleolus, to be released again at prophase, whilst the achromatic portion mingles with the karyolymph of the resting nucleus. I am certainly inclined to agree with de Litardière (1921), Martens (1922), Van Camp (1924), and Cleland (1924), that there is some correlation between the appearance of chromaticity in the matrix and the disappearance of the nucleolus and *vice versa*.

If this is true, the hypothesis of chromosome individuality need not be upset, since it is carried on by the chromonemata as suggested by Vejdovsky (1926/27).

The position in the mitotic cycle at which the split for the anaphase separation occurs has been placed at almost every stage by one or another writer, the general tendency having been to show the split at successively earlier stages as cytological technique has been improved, allowing of more accurate observations.

This matter is complicated by the fact that, although one can state at which stage the split is first *observed*, it is not possible to decide whether it has just occurred, or whether it has just become visible. In *G. nivalis* splitting is first visible in early metaphase, although it very probably actually occurs in late prophase, i.e. the prophase next but one before the anaphase in which the halves will separate to different poles. The chromatic part of the chromosome is thus divided more than a whole mitotic cycle before the parts will separate. This is in common with the observations of Kaufmann (1926), Sharp (1929), and Telezynsky (1930/1931). The chromosomes therefore possess a dual structure (by virtue of their two chromonemata) throughout their life cycle, and a quadruple one for a short time at metaphase.

The method of splitting is not easily determined; at the time of division

the chromonemata are fairly straight and it would seem that a gradual repartition of their substance takes place, leaving a free central area, the two new chromonemata moving apart and gradually twisting about one another.

Fraser (1914) has considered the bearing of the early splitting of the chromosomes on meiosis in *Vicia faba*, and concludes that the longitudinal fission begun in the last premeiotic telophase is completed at the homotypic metaphase. In this plant the heterotypic chromosomes had lost all indication of the doubleness which was manifested at the premeiotic telophase, and Digby (1919) has done similar work on *Osmunda*. Recent work by Darlington (1931) postulates the essential difference between meiosis and mitosis as depending upon the singleness of early prophase threads in the former compared with the doubleness in the latter, and he believes the singleness to be due to a "precocious onset of prophase" (p. 10). Assuming, however, that the last premeiotic mitosis is like those preceding it, the threads will already be double at leptotene, since the chromonemata split in the last mitotic prophase.

It will be interesting in studying the meiotic divisions of *G. nivalis* to note whether there is any difference between the last mitosis before the heterotypic division and those occurring in the root-tips. I am not aware that any such difference has yet been observed in any plant, but for Darlington's hypothesis to be possible some such difference will certainly be necessary.

V. SUMMARY.

1. The diploid chromosome number for *Galanthus nivalis* is 24, as found by Heitz.

2. The chromosomes show a double structure throughout their life-history and for a short while, at metaphase, they can be observed to be quadripartite.

3. There are two constituents of the chromosomes: the more chromatic, consisting of two chromonemata, and the less chromatic forming a matrix, the chromaticity of which is markedly increased from prophase to anaphase, but is completely lost during telophase. It is probable that the entrance of material from the nucleolus has something to do with this change in chromaticity.

4. The chromonema hypothesis of chromosome structure seems to fit the observations; there are also marked indications that chromomeres exist at certain stages, and a possibility of correlating the two hypotheses is suggested. No indication of doubleness arising by vacuolation can be found.

This work has been carried out in the Cytological Laboratories of the Department of Botany, University of London, King's College, under the supervision of Prof. R. Ruggles Gates, F.R.S., to whom my sincere thanks

are due for his valuable suggestions throughout, and for helpful criticism in the preparation of this paper. I would also thank Mr. D. G. Catcheside, M.Sc., who suggested *Galanthus* as a suitable medium for this investigation.

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EXPLANATION OF PLATES.

Drawings were made with the aid of a camera lucida at table level. All figures were drawn under a 2 mm. immersion Zeiss apochromatic lens (N.A.1.40) with Zeiss compensating ocular 15 or 20, giving magnifications of 2000 and 2670 respectively. Figs. 1, 6, 7, 11, and 29 were drawn at the lower magnification, all the rest at 2670 \times .

PLATE I.

- Fig. 1.—Anaphase, showing variation in length of the chromosomes, and doubleness in a large number of cases.
- Fig. 2.—Anaphase, the chromonemata beginning to twist about one another. Chromomeres present.
- Fig. 3.—Late anaphase, further twisting of chromonemata. Cell plate being laid down.
- Fig. 4.—Polar clump, matrix has become more chromatic, individual chromosomes only recognized with difficulty.
- Fig. 5.—Telophase, matrix has begun to disappear, small nucleolus visible. Cell wall quite distinct.
- Fig. 6.—Matrix completely disappeared, chromosomes represented by a pair of spirally twisted chromonemata.
- Fig. 7.—Anastomoses between chromosomes, spindle fibres have almost disappeared.
- Fig. 8.—Anastomoses still more common.
- Fig. 9.—Large, alveolar nucleolus present.
- Fig. 10.—Late telophase, the individual chromosomes are barely distinguishable.
- Figs. 11 and 12.—Resting nuclei, still showing doubleness of threads.
- Figs. 13 and 14.—Nucleoli in process of budding.
- Fig. 15.—Shows difference in size of three nucleoli in a resting nucleus.

PLATE II.

- Fig. 16.—Resting nucleus with continuous reticulum.
- Fig. 17.—Resting nucleus with two nucleoli.
- Fig. 18.—Resting nucleus with large granules between the meshes of the reticulum.
- Fig. 19.—Early prophase—doubleness of many of the threads is obvious.
- Fig. 20.—Early prophase, irregular nucleolus.
- Fig. 21.—Prophase—with chromomeres—irregular nucleolus.
- Fig. 22.—More condensed threads, most of granular appearance lost.
- Figs. 23 and 24.—Later prophase, threads contracted.
- Fig. 25.—Very late prophase, threads shorter, and almost as stout as chromosomes at metaphase—polar caps just visible.
- Fig. 26.—Metaphase—the split, and in some cases, the attachment constriction of the chromosomes is visible.
- Figs. 27 and 28.—Quadruple structure visible at late metaphase.
- Fig. 29.—General view of metaphase showing spindle fibres.
- Fig. 30.—Quadruple metaphase structure obvious in some chromosomes.

XVII.—SOME RADIOLARIA FROM THE TRICHINOPOLY CRETACEOUS *—S. INDIA.

By L. RAMA RAO, M.A., F.G.S.

(Read May 18th, 1932.)

ONE PLATE.

IN a paper on the phosphatic nodules from the Utatur stage of the Trichinopoly cretaceous published some time back,† attention was drawn by the present writer to the occurrence of a large number of formamiferal remains noticed in several of the sections. In the course of a more detailed examination of a number of micro-sections of the same material recently, a large number of radiolarian remains have been recognized and the present paper is intended to give a brief preliminary account of these. Though our knowledge of cretaceous radiolaria from other parts of the world is fairly extensive, yet so little is known regarding this group from the South Indian cretaceous that no apology is needed in submitting even a brief account of these forms such as is contained in the present paper. It must be mentioned at the outset, however, that in many of these sections now under study these minute fossil structures are so poorly preserved and are so fragmentary in character that it is hardly possible to say anything more definite about them than that they are referable to the group Radiolaria. But now and then we come across sections where these radiolarian remains are fairly complete and show enough of their structure and characters to help us in a more definite identification; and the present paper deals with some of the more interesting of these well-preserved and recognizable forms.

DESCRIPTION OF FORMS.

Order : SPUMELLARIA.

Cenosphaera.—As is well known, the genus *Cenosphaera*, with a single lattice sphere and a simple shell cavity, is the simplest form of all the Sphaeroidea. This form is commonly noticed in many of our sections, in several of which the regular spherical outline and the internal mesh structure

* What is known as the Trichinopoly cretaceous of South India can be divided into four stages. Starting from the oldest these are (i) the Utatur, (ii) the Trichinopoly, (iii) the Ariyalur, and (iv) the Niniyur, ranging in age from the Cenomanian to the Danian.

† "Quart. Jour. Geo. Min. Met. Soc. of India," Vol. 3, No. 2, May, 1931.

are very clear. In some sections, however, only the outer rim of the lattice sphere is seen, the central portion being more or less removed. In other cases only fragments of the central meshed portion are seen without the complete outline. The regular spherical outline and the complete absence of spines enable us to recognize this form easily. In size there is a good deal of variation, the diameter ranging from 0.078 mm. to 0.208 mm.

Staurosphaera (or *Spongostaurus*?).—Several forms referable to one or the other of these genera are seen in the sections, it being not always possible to distinguish between the two.

Section P7 (pl. I, fig. 1). Here the rounded margin of the lattice sphere is clearly seen, but only a portion of the internal meshed structure is visible along one margin. Two of the spines are distinct and their position suggests that there must have been two more at right angles to these. The spines appear to be hollow.

Diam., 0.13 mm. Length of spine, 0.075 mm.

Section P25 (pl. I, fig. 2). In this case the outline of the central lattice sphere is distinct, but the mesh structure is all gone and is replaced by a dark homogeneous material. Two spines are very clear and just the stump of a third spine is also visible on close examination. Altogether there is no doubt that the entire form must have possessed four spines. These spines appear to be solid and are continuous to the centre where they cross at right angles. This character suggests that the form is probably *Spongostaurus*.

Diam., 0.13 mm. Length of spine, 0.104 mm.

In the same section we get another form where we see the circular outline of the lattice sphere, with the mesh structure just seen along portions of the margin. Three of the spines are clear and there is reason to believe that there must have been a fourth. When this is restored, it will be seen that the spines are not quite at right angles.

Diam., 0.078 mm. Length of spine, 0.042 mm.

Odontosphaera.—This form may be considered as belonging to the *Astrosphaerida*, characterized by the possession of a lattice sphere, the outside of which bears numerous radial pointed spines, regularly arranged. This form is recognizable only in four sections.

Section P25 (pl. I, fig. 3). Here the actual mesh structure of the lattice sphere is all gone, but we distinctly see the rounded outline of its margin, which bears a large number (nearly 50) of equal sized radial spines, slender and pointed.

Diam., 0.143 mm.

Xiphostylus.—This interesting form is one of the *Stylosphaerida* and is characterized by a single lattice sphere bearing two free spines opposite to each other but unequal in size. In the form *X. ardea* figured by Zittel ("Palaeontographica," Vol. 38, Taf. X, fig. 1) he has shown one prominent long spine at one pole and a cluster of five smaller spines at the opposite pole.

Section 56 (pl. I, fig. 4). Here we get a form with a simple spherical



Fig. 1



Fig. 2



Fig. 3



Fig. 4



Fig. 5

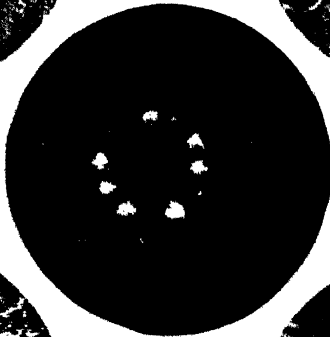


Fig. 6



Fig. 7



Fig. 8

lattice sphere showing only one prominent and elongated spine, while at the opposite pole nothing is clearly seen, though it is quite possible that there was another smaller spine here as required by the genus *Xiphostylus* or a cluster of small spines as mentioned in the case of *X. ardea*. Since, however, there does not seem to be any type of Sphæroidea with only one spine, I have presumed that there must have been at least a single small spine at the pole opposite to the one where we see the big spine and have therefore considered the form as identical with *Xiphostylus*.

Diam., 0.117 mm. Length of spine (portion seen), 0.156 mm.

Rhopalastrum.—This genus has been defined as including those Porodiscida which possess three simple undivided chambered arms without a patagium, and is distinguished from other similar members of the group by the different size of the three angles and often also in the divergent form and size of the three arms, one odd arm being opposite to the odd angle between the two paired arms.

Section P57 (pl. I, fig. 5). Here we get a form generally conforming to the above description. Two of the three arms are clearly seen—one more fully than the other—and the mesh structure in each is very clear. The third arm is not seen, but there is no doubt that it existed. If we restore the full form by imagining the third arm in its proper place it looks as though the two arms now seen are the paired, and the missing one would be the median unpaired one.

Carposphæra (?).—In the *Challenger* Expedition Report on the Radiolaria, Haeckel defines this interesting genus as follows: "This genus comprises a large number of double-shelled Sphæroidea, characterized by the absence of radial spines. The shell is composed of two concentric lattice spheres, the inner of which (the medullary shell) is situated within the central capsule and the other (the cortical) outside it. Both shells are connected by radial beams which pierce the wall of the central capsule."

Section P35 (pl. I, fig. 6). In this section we get a form which appears to generally conform to this description. The meshed structure in the medullary shell, however, is not clearly seen. In their Monograph on the Radiolarians, Dunker and Zittel have described and figured ("Palæontographica," Vol. 31, III, FVII, Taf. III, fig. 9) a species of *Carposphæra*—*C. distinguenda*—with which the form in our section also agrees fairly closely, except that whereas in the former there are ten lattice pores mentioned around the inner shell, the number in our section is twelve. The genus *Liosphæra* is closely allied to *Carposphæra*, the difference being that whereas in the latter the distance between the shells is at least as large as (commonly much larger than) the radius of the inner shell, in the former case this distance is much smaller. From this point of view our section inclines to be nearer *Liosphæra*.

Diam. of outer shell, 0.078 mm. Diam. of inner shell, 0.028 mm.

Order : NASSELARIA.

Lithocampe (pl. I, fig. 7).—This genus includes those Cyrtioidea in which the lattice shell is composed of numerous (4-8 or more) annular joints and bears no radial apophyses. Practically all the forms in our sections referable to the Nasselaria appear to belong to this genus, though in one or two cases some similarity to another genus—*Dictyomitra*—is indicated. Several very good sections of *Lithocampe* are recognizable and the characters noticed may be summarized as follows :

	No. of Segments Noticed.	Length.	Breadth.
P19a	11	0.43	0.143
P19b		0.39	0.143
P44 ..		0.195	0.078
P47 ..		0.195	0.091
P41 ..		0.156	0.052

DOUBTFUL FORM.

P25 (pl. I, fig. 8). Here we have a very good section where the mesh structure, though only partly preserved, is very clear, and even the details of the wall of the meshes can be made out. Arising from the outer margin of the lattice sphere may be seen five distinct spines, which appear to be of equal length and arranged in accordance with a radial symmetry.

Diam., 0.208 mm. Length of spine, 0.143 mm.

P56. In this section we get a form similar to the above. Though the mesh structure is not seen the outline is very clear and is seen to be almost pentagonal, with a spine radiating from each of the angular points. Only three of these spines are distinctly seen, but there is enough indication, though faint, of the presence of two other spines and the position of these could certainly be recognized.

Both these forms agree in possessing five spines, a character which it has not been possible to reconcile with any type I have been able to compare.

In conclusion, I wish to offer my thanks to the Director, Geological Survey of India, for permitting me to make use of the extensive library in the office of the Geological Survey at Calcutta in connection with this work.

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DESCRIPTION OF PLATE.

Fig. 1.—*Staurosphæra* (or *Spongostauris* ?).

Fig. 2.—

Fig. 3.—*Odontosphæra*. ”

Fig. 4.—*Xiphostylus*.

Fig. 5.—*Rhopalastrum*.

Fig. 6.—*Carposphæra* ?

Fig. 7.—*Lithocampe*.

Fig. 8.—Genus (?).

All the photo-micrographs are about $\times 125$, except fig. 6, which is about $\times 250$.

591. 81. XVIII.—THE LIFE-HISTORY OF THE NUCLEUS AND NUCLEOLUS
AND THE EFFECTS OF β RADIATION UPON THEM.

By J. C. MOTTRAM, from the Mt. Vernon Hospital, Northwood, and the
Radium Institute, London.

(Read November 16th, 1932.)

SEVEN TEXT-FIGURES.

It has been long known (1904 and 1922) that the exposure of cells to radiation inhibits mitosis. How this is brought about is, however, unknown. Changes in the resting nucleus have been described, but without correlation to the inhibition of mitosis. For instance, Cheatle and Ludford (1930) describe a relative increase of oxychromatin and a decrease of basichromatin in the nucleus following radiation. Love (1931) found a discontinuity in the radio-sensitivity of non-dividing cells 180 minutes back from prophase, indicating some abnormality of the cell after radiation, as it evolves or grows in the inter-mitotic period.

The work of Strangeways and his colleagues (1926-32) has shown that when tissue cultures are irradiated some cells are prevented from dividing and that the greater proportion of the cells affected are about 80 minutes back from mitosis. These results suggest that non-dividing cells are not equally affected by radiation, and that in their growth from one mitosis to the next, radiation may hold up their evolution at one or more stages.

A detailed study of the life-history of the non-dividing nucleus under radiation has therefore been made to see what nuclear changes occur, whether they can be correlated with the inhibition of mitosis, and whether they give information as regards the normal life-history of the nucleus.

EXPERIMENTAL FINDINGS.

The root-tips of beans were chosen, since their behaviour under radiation was known from former investigations, and their nuclei are very large and contain a well-developed nucleolus. A radium applicator of 60 mgrms., area 4 sq. cm., screen 0.12 silver was used. An exposure of 4 minutes suffices to inhibit growth temporarily, whereas 10 minutes, here used, permanently stops growth in from 3 to 5 days. Many fixatives and staining

methods were employed, but unless otherwise stated, Zenker with iodine gentian violet, or Feulgen's stain, was used.

On examining the nuclei from normal specimens they are seen to vary widely in structure. Examples are shown in fig. 1.

Young nuclei (*a* in fig. 1) are easily recognized by their small size, by occurring in small cells, and by the occurrence of these cells in pairs. The nucleolus is large and oval, the chromatin network coarsely granular and close meshed. In the next stage (*b* in fig. 1) the nucleus is likewise small and the cells tend to occur in pairs, resulting from cell division. It differs from the first stage in having an excentric vacuole around the nucleolus. The vacuole is perfectly clear and structureless and has the appearance of a clear fluid derived either from the nucleolus or the rest of

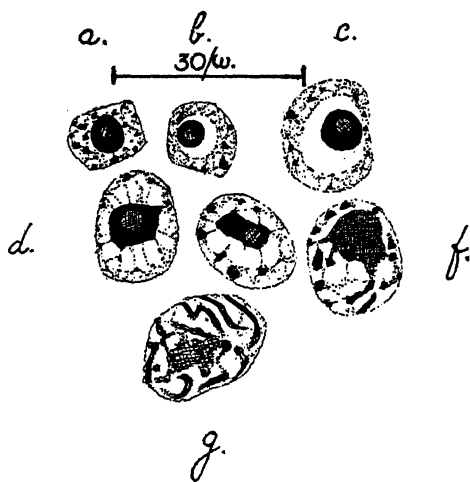


FIG. 1.—Nuclei from a longitudinal section of a normal root fixed in Zenker and stained with iodine gentian violet. The scale in all the figures is the same as that here used.

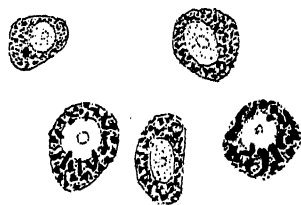


FIG. 2.—Nuclei from a longitudinal section of a normal root fixed in formol-Müller and stained with gentian violet. The scale is as in fig. 1. Note the smaller size of the nuclei, the closer arrangement of the chromatin network in all stages, and that the nucleolus does not take the dye, and is not surrounded by a vacuole.

the nucleus. If a root be fixed in formol-Müller, it is found that the nuclei are much smaller (see fig. 2) and also that the vacuole does not form; the nucleolus remains the same size. It appears, therefore, that fixation with Zenker causes swelling of the nucleus but not of the nucleolus, thus a disruption occurs between the two. Formol-Müller preserves the natural appearances of the nucleus better than any fixative tried, but is by no means therefore a good fixative for the study of structure which is often only brought out by distortion, alteration in refractive index, and staining qualities. What may be described as the third stage (*c* in fig. 1) is a nucleus much enlarged and containing a large perinucleolar vacuole; this type of nucleus is especially common in those parts of the root-tip where cell multiplication has ceased.

Turning now to the other end of the life-history of the resting nucleus, namely, at just before prophase, the appearance (*g* in fig. 1) which may be termed the spireme stage is seen. The chromatin is concentrated into bands forming the spireme, which at a number of points is attached to an irregular mass, not deeply stained, of chromatic material representing the nucleolus. Tracing back the life-history, a pre-spireme stage is found (*f* in fig. 1) where the chromatin network is very coarsely granular and shows short bands of chromatin; the nucleolus is a large irregular-shaped body not staining very deeply. Passing farther backwards through *e* in fig. 1, one comes to "the wheel" nucleus, to give it a useful descriptive term (*d* in fig. 1). Here the chromatin network, which has gradually been getting less coarse, is finely granular and tends to be arranged around the nucleolus like the spokes of a wheel, the nucleolus forming the hub. The nucleolus

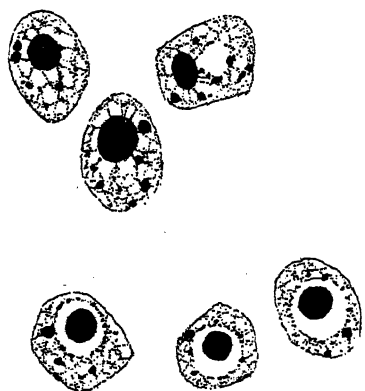


FIG. 3.—Adjacent nuclei from a radiated root, the upper three in "the wheel" stage, the lower three vacuolated.

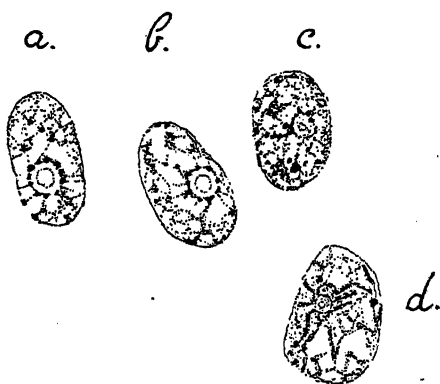


FIG. 4.—Nuclei from a normal root fixed in Zenker and stained by Feulgen's method.

is large and irregular in outline as if drawn out into points by the wheel spokes.

Thus the nucleus has been traced forwards to the large nucleus with a large perinucleolar vacuole, and backwards to "the wheel" nucleus; but how "the wheel" nucleus is evolved from the vacuole nucleus is not evident.

Diverting now to roots which have received β radiation, it was found that cell division had almost ceased 3 days after exposure, and in these specimens the nuclei were almost all either in the vacuole stage or "the wheel" stage. In these two stages, it appears that the evolution of the resting nucleus is held up as a result of the radiation. In the case of cessation in the vacuole stage, it has been mentioned that this commonly occurs where cell multiplication is in abeyance; here, therefore, radiation may be only promoting a normal process. In the case of "the wheel" stage this does not

appear to be the case; its common occurrence after radiation suggests that an abnormality is occurring, and especially because the nucleoli are not irregular in shape as they are in normal specimens, but large and rounded. Compare the upper three nuclei in fig. 3 with *d* in fig. 1. If a further analysis of these nuclei be made by staining with Feulgen's method, another difference between the radiated and normal is brought out. The normal appearances are shown in fig. 4. The spireme stage is shown (*d* in fig. 4). It is seen that the unstained nucleolus is small and embedded in a mass of stained chromatic material to which the spireme is attached at several points. (It is now generally agreed that the spireme is not a single filament.) The irregular mass representing the nucleolus (see *g* in fig. 1) appears, therefore, to be feebly staining chromatic material in which the nucleolus is embedded and concealed. The pre-spireme stage (*c* in fig. 4) likewise shows the nucleolus retaining its oval shape, though small and surrounded by granules of chromatin, so that the irregular shape of the nucleolus seen in *e* and *f* in fig. 1 does not represent the nucleolus but the nucleolus with surrounding chromatin granules, which latter give it its irregular outline.

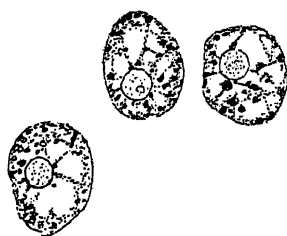


FIG. 5.—“Wheel” nuclei from a radiated root stained by Feulgen's method.

Lastly, in “the wheel” nucleus stained by Feulgen's method (*a* and *b* in fig. 4), there is seen a ring of chromatin granules closely adherent to the nucleolus, again giving it the irregular shape seen in *d* in fig. 1. Examining now “the wheel” nucleus stained with Feulgen in radiated specimens (fig. 5), it is at once evident why the nucleolus retains its round or oval outline, namely, because there are no chromatin granules adherent to it. The fact that in spireme and pre-spireme nuclei the nucleolus is embedded in a mass of chromatin material to which the spireme is attached, can be demonstrated by the following method.

Transverse sections 2μ thick are cut, stained with gentian violet, and decolorized with spirit until only the nucleoli remain stained; they are then mounted without counter-staining or stained with watery neutral red. Thus treated, the nucleolus is stained violet and the chromatin either unstained or stained red. It can then be seen (fig. 6) that the nucleolus is embedded in a mass of chromatin to which the spireme is attached. The life-history of the nucleus has now been traced up to the vacuole stage and from “the wheel” stage until just before prophase.

The question remains, how are these stages connected? If one examines many nuclei stained by Feulgen's method, appearances shown in fig. 7 *d*, *e*, *f*, are occasionally found. Here is seen crossing the vacuole one or more very fine strands attached internally to the surface of the nucleolus, and externally to the chromatin network, almost always to a chromatin granule on the network. These strands appear to be of the same material as the nucleolus, i.e. unstained by Feulgen but stained by gentian violet. The appearances seen with the latter staining are shown in fig. 7 *a*, *b*, *c*.

If now one refers back to fig. 1 *d*, it is evident that "the wheel" nucleus only differs from the nuclei shown in fig. 7 in having many strands across

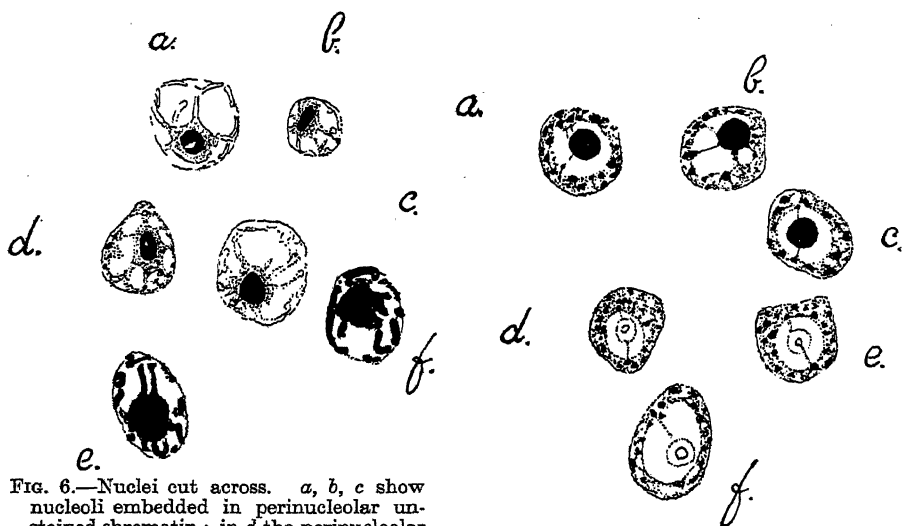


FIG. 6.—Nuclei cut across. *a*, *b*, *c* show nucleoli embedded in perinucleolar unstained chromatin; in *d* the perinucleolar material is slightly stained neutral red; in *e* and *f* similar nuclei are stained with gentian violet without high differentiation; here the perinucleolar material conceals the true nucleolus.

FIG. 7.—Nuclei from normal roots fixed in Zenker, the upper three stained with gentian violet, the lower with Feulgen's; they show strands connecting the nucleolus with the chromatin network across the vacuole.

the vacuole; indeed, the vacuole around the nucleolus is still present, and so also in fig. 1 *e*, fig. 1 *f*, and in fig. 4 *a* and *b*: in these cases it is only masked by the crossing of many strands.

This completes the description of my observations, and in order to give a clear picture of the results the following tentative interpretation is put upon them, more for purposes of description than as an insistence upon their validity.

The young nucleus immediately after cell division has no vacuole around the nucleolus, but in older nuclei, under Zenker and most other fixatives, a vacuole forms around the nucleolus, showing that it has then no attachment to the chromatin network. As the nucleus grows larger, the perinucleolar

vacuole increases in size, the nucleolus still therefore remains free. Next, strands are found crossing the vacuole, sometimes only one or two, but usually more numerous, as seen in "the wheel" nucleus. These strands generally pass out to chromatin granules. Thus there is evidence that the nucleolus, which was at first unattached to the chromatin network, becomes later connected to it. (Like the vacuole stage, "the wheel" nucleus formed by filaments crossing the vacuole is, of course, an artifact.)

The next stage is the accumulation of a ring of chromatin granules around the nucleolus (how this comes about is uncertain; they may be existing granules of the chromatin network drawn to the nucleolus, or, perhaps, fresh granules formed by the nucleolus). These granules conceal the true nucleolus under many conditions of staining and give it an irregular outline. As the resting nucleus develops and passes into the pre-spireme and spireme stage, the accumulation of perinucleolar chromatin increases whilst the nucleolus decreases in size (as if the nucleolus was forming the chromatin). It is to this perinucleolar chromatin that the spireme is attached. The nucleolus finally disappears when the nuclear membrane breaks down.

Beta radiation under conditions sufficient to inhibit cell division does not appear to produce qualitative changes; it does, however, hold up the evolution of the resting nucleus at two stages: firstly, at the vacuole stage (this appears to be the stage where normally the evolution of the resting nucleus pauses in situations where cell division has ceased); and, secondly, after attachment of the nucleolus to the chromatin network, that is, at "the wheel" stage, as if the subsequent accumulation of chromatin around the nucleolus suffered inhibition.

DISCUSSION.

It is now generally agreed that the spireme becomes attached to the nucleolus; this was first described by Wager (1904) in the root-tip of beans, the material here used. The suggestion here made is that this connection between nucleolus and chromatin network occurs at a much earlier stage in the life-history of the resting nucleus, namely, at "the wheel" stage.

The question as to whether the nucleolus supplies chromatin or other material for the spireme and chromosomes is very controversial; see Fikry (1930). If it does, then the beginning of this manufacture may require to be put back to "the wheel" stage. Several observers, for instance Zirkle (1931), have postulated two substances or parts of the nucleolus—a chromatin part which goes to the chromosomes, and a non-chromatic part which fragments during mitosis and is reformed at telophase.

The perinucleolar material described in this paper would correspond to the former, the "true nucleolus" to the latter.

Selim (1930) has described these two parts forming separate nucleoli in the pollen mother-cells of rice.

It is evident that the life-history of the nucleolus is a controversial subject; if, however, it is related to chromatin, to the spireme, and to chromosomes, it is not unreasonable to suggest the possibility that this relation may occur earlier than has hitherto been thought.

As regards the radiological aspects, the results suggest that the evolution of the resting nucleus is held up at two places—at the vacuole and at “the wheel” stages. The latter stage is not far removed from mitosis and may correspond with the 180 minutes back from mitosis (Love) or the 80 minutes back (Spear) periods where experimental evidence indicates that radiation effects a change in the evolution of the non-dividing cell. In keeping with this is the fact that cells not far removed from mitosis in the spireme and pre-spireme stages are not found in radiated specimens. They are inhibited just as in mitosis. Now the number of resting nuclei in normal roots, between “the wheel” stage and early prophase, is a small percentage of all the resting nuclei, indicating that “the wheel” stage in point of time may not be very far removed from prophase.

Those who follow the interpretations of Crowther (1926) to account for the sigmoid mortality curves of *Colpidium colpoda* exposed to X-rays, may be willing to look upon the nucleolus as the particle in the cell which he postulates is especially sensitive. He imagines a particle having a diameter of 3.5×10^{-5} cm. The nucleolus of the bean is much larger than this, about 6μ , but on the other hand, the bean root is very much more sensitive than is *colpoda*.

The importance of the nucleolus could perhaps be ascertained by comparing the sensitivity of cells having nuclei of widely different sizes.

CONCLUSIONS.

The life-history of the resting nucleus and nucleolus has been traced. It is concluded that the nucleolus becomes attached to the chromatin network much before the formation of the spireme, that this attachment occurs at “the wheel” stage, and that before this it is unattached.

An increasing accumulation of chromatin occurs around the nucleolus from “the wheel stage” onwards, and it is to this the spireme is attached, not to the true nucleolus. As the perinucleolar chromatin increases in amount, so the nucleolus decreases in size.

There is evidence that the nucleolus consists of two parts, chromatic and non-chromatic.

With regard to the effects of β radiation, it is concluded that the evolution of the nucleus is held up at two stages—the vacuole stage and “the wheel” stage—and that the inhibition of mitosis is brought about by the nucleus ceasing to grow beyond these stages.

The radium used was on loan from the Medical Research Council.

I am indebted to Prof. Ruggles Gates for kindly giving me his valuable advice and criticism.

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535. 826. 8. XIX.—A RAPID TECHNIQUE FOR THE PERMANENT MOUNTING OF MINUTE FRESH-WATER ORGANISMS.

By PETER GRAY, Ph.D., A.R.C.S. (Lecturer in the Department of Zoology of the University of Edinburgh).

(Communicated by Dr. C. Tierney, October 19th, 1932.)

THIS technique has been evolved for the use of those carrying out routine examinations of the fauna of fresh waters. There are many cases where specific identification of protozoa and minute larvæ is not possible at sight and the existing technique for the permanent preservation of these forms is frequently so cumbersome that the whole investigation becomes interrupted for the sake of a single specimen.

The methods outlined below enable the majority of minute fresh-water organisms to be permanently fixed to a slide for storage in 70 per cent. alcohol within less than a minute of the organism being noticed; the staining technique must of necessity be varied according to the subject, but with the aid of the special hæmatoxylin-eosine technique given, double-stained balsam mounts will be ready for examination in from 3 to 5 minutes.

The range of possible application of this method is very wide, the notable exceptions being Rotifers and stalked ciliates, the contraction of which cannot, of course, be overcome without prolonged narcotization, and which are in any case better identified during life or after treatment by Rousselet's method. The other important exception is nematode worms, whose thick, smooth cuticle both renders them very liable to distortion and greatly hinders any attempt at fixation to a slide. Permanent mounts have actually been prepared of *Amœba*, *Diffugia*, and *Centropyxis* among Rhizopods, *Volvox*, *Euglena*, and *Rhipidodendron* among Flagellates, this last colonial form being as readily attached to the slide as the individual forms; a wide range of free and semi-parasitic ciliates, though the very highly contractile forms *Spirostomum* and *Dileptus* are only about a quarter extended; the only intestinal ciliates so far tried have been *Opalina* and *Nyctotherus*, but the complete success of these leaves no doubt that any such form could be as easily handled. Several members of the gastrotrichid genus *Chaetonotus* have been mounted without difficulty while the turbellarians *Microstomum* and *Macrostomum* have been equally susceptible to treatment. Only two larvæ, the miracidium of *Fasciola* and an unidentified form, have been available for test and have both yielded excellent mounts.

It is thus seen that almost anything to be found between 3 mms. long and

the limit of visibility of a dissecting microscope can be prepared by the method about to be described. Though at first sight the materials are numerous and some of the formulæ a trifle complicated, these preliminary difficulties are amply repaid, once the set has been assembled, by the results obtained.

The following are required for the fixation, and the fluids may most conveniently be kept in "pipette drop bottles"; ether, of course, cannot be so stored and is better in an ordinary stoppered drop bottle:

70 per cent. alcohol.

Ether. 40 per cent. Formaldehyde. Glacial acetic acid.

"Basal fixative solution."

Picric acid, 1 gram.

Mercuric chloride, 1 gram.

95 per cent. alcohol, 100 c.c.

Mayer's albumen, clean slides, several 2-inch \times $\frac{1}{2}$ -inch specimen tubes in stand, pipettes, writing diamond, staining trough (or jar) of 70 per cent. alcohol, strips of filter-paper.

This list, elementary though some of the details may sound, has been set out in full as I myself find it very useful to have a list from which to check *all* items before starting on the examination of a collection. Before commencing work as many slides as are likely to be required are finally cleaned by being rubbed with 1 per cent. acetic acid in 95 per cent. alcohol and then dried with a clean duster; a small drop of Mayer's albumen is placed in the centre of each and rubbed down with an alcohol-cleaned finger into a patch of about 1 cm. diameter. The albumen should be somewhat thicker than would be the case were serial sections to be mounted and it is better to have too much than too little.

The collection is examined under a dissecting microscope and those forms of which it is likely that a mount will be required are roughly noted. The necessary fixatives are then prepared (in the specimen tubes mentioned in the list) according to the following formulæ:

(1) *For protozoa.*

Basal fixative solution	..	..	..	..	10 drops.
Ether	..	..	..	..	3 "
Glacial acetic acid	..	..	..	..	2 "
40 per cent. Formaldehyde	..	..	..	..	5 "

(2) *For heavily cuticularized forms.*

Basal fixative	..	..	..	..	10 drops.
Ether	..	..	..	..	1 drop.
Glacial acetic acid	..	..	..	..	4 drops.
40 per cent. Formaldehyde	..	..	..	..	5 "

(3) *For delicate larvae.*

Basal fixative solution	..	..	..	..	10 drops.
Ether	..	..	..	..	2 "
Glacial acetic acid	..	..	..	..	1 drop.
40 per cent. Formaldehyde	..	..	..	..	5 drops.

These fixatives, each of which is the result of many experiments, may be regarded as modifications of Yocom's fluid, though they were, in my case, originally evolved from Dubosq-Brasil. They are unstable and it is, moreover, a source of surprise to me that they do not cause either disintegration or distortion of even the most delicate objects. Their great advantage is that they cause a layer of Mayer's albumen to become intensely sticky and to remain in that condition until treated with alcohol.

Any object which it is desired to mount is now taken up in a pipette with the least possible quantity of water and placed on the patch of albumen, beyond the limits of which the water should not run. The surplus fluid is then drawn off, sufficient, however, being left for the animal to swim naturally; some forms are surprisingly sensitive either to the glycerine-albumen or to the sodium salicylate in it and should be fixed as rapidly as possible, even though this involves leaving the surplus water. Rhizopods should also be left in plenty of water in which to expand. The animal is watched until it is in a fairly normal position and a large drop of fixative allowed to fall on it from above. Where the full amount of water brought over has been left, it is often advisable to suspend fixation until the animal has reached the edge of the drop. The quantity of water remaining has no effect whatever upon the ultimate attachment of the object and need only be reduced to avoid displacement of the objects by diffusion currents.

Immediately the fixative has reached the water, diffusion currents of almost explosive intensity result and considerable care must be taken to keep the rapidly moving object within the field of the dissecting microscope. If the object leaves the area of albumen it must be guided back with a fine glass needle whose point will collect a capillary droplet of the fluid. When the animal is in the desired position, all surplus fluid, which will by now have collected into drops moving slowly over the surface of the slide, is removed with a filter-paper. The object is now closely watched under the dissecting microscope *until the droplet of fluid which will have collected round it has so far evaporated as clearly to show the outlines of the object*. When evaporation has proceeded far enough, the slide is gently flooded with 70 per cent. alcohol; the correct point at which to do this is easily recognizable with practice but is difficult to describe in words other than the above. If evaporation be allowed to proceed too far the animal, especially if it be spherical, is liable to become distorted; if it be arrested too soon the animal is liable to become detached. While the 70 per cent. alcohol is taking effect a small circle is cut round the object with a writing diamond, as once lost from the field of the dissecting microscope small protozoa are almost impossible to distinguish from specks of dust acquired in the fixing process. It is also useful to write either a reference number or make a cross on the corner of the slide in order subsequently to distinguish the side of the slide upon which the object is fixed. A few seconds after the 70 per cent. alcohol has first been applied to the slide, this latter may be transferred to a trough of alcohol to await further treatment, or stained immediately.

Though this process is somewhat lengthy to describe it is very rapid in operation and has several advantages over the usual cover-slip or film method. In the first place, one is quite certain of getting an individual object firmly fixed to a given portion of a slide and in a position, moreover, where it can be immediately found again. Further, the object is never at any time allowed to dry and become distorted, nor yet has one to wait for a long time—as in the usual rhizopod technique—for a film of water to evaporate.

Staining may be carried out by any method. Where time is of primary importance, I would recommend the following, above all for protozoa and larvæ.

As soon as the yellowish colour has been removed (a few seconds) a drop of Ehrlich's hæmatoxylin is placed on the object and left until the nucleus or nuclei are clearly shown. Representative times are 30 seconds for *Paramœcium* and 3 minutes for a miracidium larva. The excess stain is then run off the slide with 95 per cent. alcohol (*never* water) and followed by a brief flushing with acid alcohol (0.25 per cent. HCl in 70 per cent.). This is almost instantly washed off with tap water or, better still, Scott's tap water substitute. When the stain is properly "blued" (do not use ammonia vapour or the object will become detached), stain for a few seconds in 0.5 per cent. eosine in 50 per cent. alcohol, rinse off in 95 per cent. or absolute, clear in terpineol and mount in balsam.

This method is both rapid and certain and yields, as already stated, permanent, double-stained mounts in less than 5 minutes from the time the object was first noticed.

XX.—ON THE MORPHOLOGY OF *BALANTIDIUM SUSHILII* N.SP., FROM *RANA TIGRINA* DAUD.

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(FROM THE DEPARTMENT OF ZOOLOGY, CALCUTTA UNIVERSITY.)

(Read November 16th, 1932.)

ONE PLATE AND FIVE TEXT-FIGURES.

1. INTRODUCTION.

THE ciliate that I have found in the intestine of *Rana tigrina* has some resemblance to *Balantidium gracile* Bezenberger (1), in shape and in minor features, but, as it will be made clear from the following description, in certain details it differs strikingly from this and all other species of the genus described hitherto. I name it *Balantidium sushilii* n.sp.*

I have attempted to give a full morphological account of this species of *Balantidium*, and I hope that this may also throw some light on the less-known morphology of *B. gracile*.

Bhatia and Gulati (2) in 1927 recorded *B. gracile* from *Rana hexadactyla* and *R. tigrina* in the Punjab, but their figure and the description they give are very poor and one cannot be certain whether they were really dealing with that same species. Moreover, the situation of the micronucleus—at some distance from the macronucleus—would in itself have warranted these authors in describing this ciliate as something out of the ordinary, because in *B. gracile*, as described by Bezenberger, the micronucleus accompanies the macronucleus.†

2. MATERIAL AND METHODS.

Abundant supply of specimens was obtained from the intestine of two frogs procured from a tank in the suburbs of Calcutta. Observations on the living organism were made in saline under a cover-glass, the edges of which were sealed with vaseline. Smears were fixed either in Schaudinn's fluid for half an hour or in Brasil's modification of Bouin and Dubosecq's

* I have named this species after my friend Dr. Sushil Basu, who collected the specimens from the suburbs of Calcutta and very kindly placed them at my disposal.

† "Der Mikronukleus liegt gewöhnlich einem Endedes Kerne an" (1, p. 152).

fixative for 20 minutes. The latter fluid proved to be the better fixative of the two for this ciliate; and my observations here are based on the smears fixed in this fluid and subsequently stained in Heidenhain's hæmatoxylin. In order to study the morphology in detail, the infected portions of intestine were fixed in the alcoholic Bouin for 24 hours and then cut 5μ thick and stained in Heidenhain's hæmatoxylin. Microphotographs were taken with an ordinary camera, the source of illumination being a point-light bulb; no filter was used in this process. The highest combination of lenses used for this purpose was No. 20 compensating ocular and 2 mm. apochromat dry objective (both by Zeiss).

3. OBSERVATIONS ON *Balantidium sushilii* N.SP.

This ciliate was found chiefly in the small intestine. A very small number were seen in the duodenal region. The organism moves about briskly amongst the slimy contents of the gut, and this renders it difficult to observe in the living condition. The body is extremely pliable and can with great ease squeeze its way through the viscous medium. Its progress is further facilitated by its rigid, pointed anterior end, which moves from side to side and pushes the débris out of the way. There is also a boring movement, and the ciliate then spins round its own longitudinal axis. This movement becomes very distinct when a resistance is offered by the surrounding débris or by a mass of torn-off intestinal epithelium in a freshly prepared smear. The fact that the ciliate actually bores through the epithelium I have been able to confirm from study of sections of the infected intestine. A slight backward movement is also exhibited. When freed from débris, *Balantidium sushilii* progresses without changing its shape and appears like a torpedo with its fore end slightly bent towards one side (see pl. I, fig. 1, and text-fig. 1).

In the living condition a hyaline, style-like structure is often seen imbedded in the cytoplasm of the left peristomial area. This style begins at the anterior end and thins out gradually as it passes backwards; it ends at a small distance beyond the mouth. In the peristomial region intracytoplasmic fibres running from all directions towards the pellicle are visible in the living state, although the definite course of their distribution can be seen only after fixation and staining. In all probability it is this hyaline style, together with its surrounding fibres, that keeps the mouth end of the organism rigid and at the same time mobile in the semi-fluid medium of the intestinal tract, and also helps the organism to bore through the intestinal epithelium. The ciliate certainly injures the intestinal epithelium of the host and is often seen lying in the submucosa.

I shall now show in tabular form (see Table I) how my species differs from that described by Bezzenberger, and I shall then describe its structure in detail, so far as I have been able to arrive at this from my preparations.

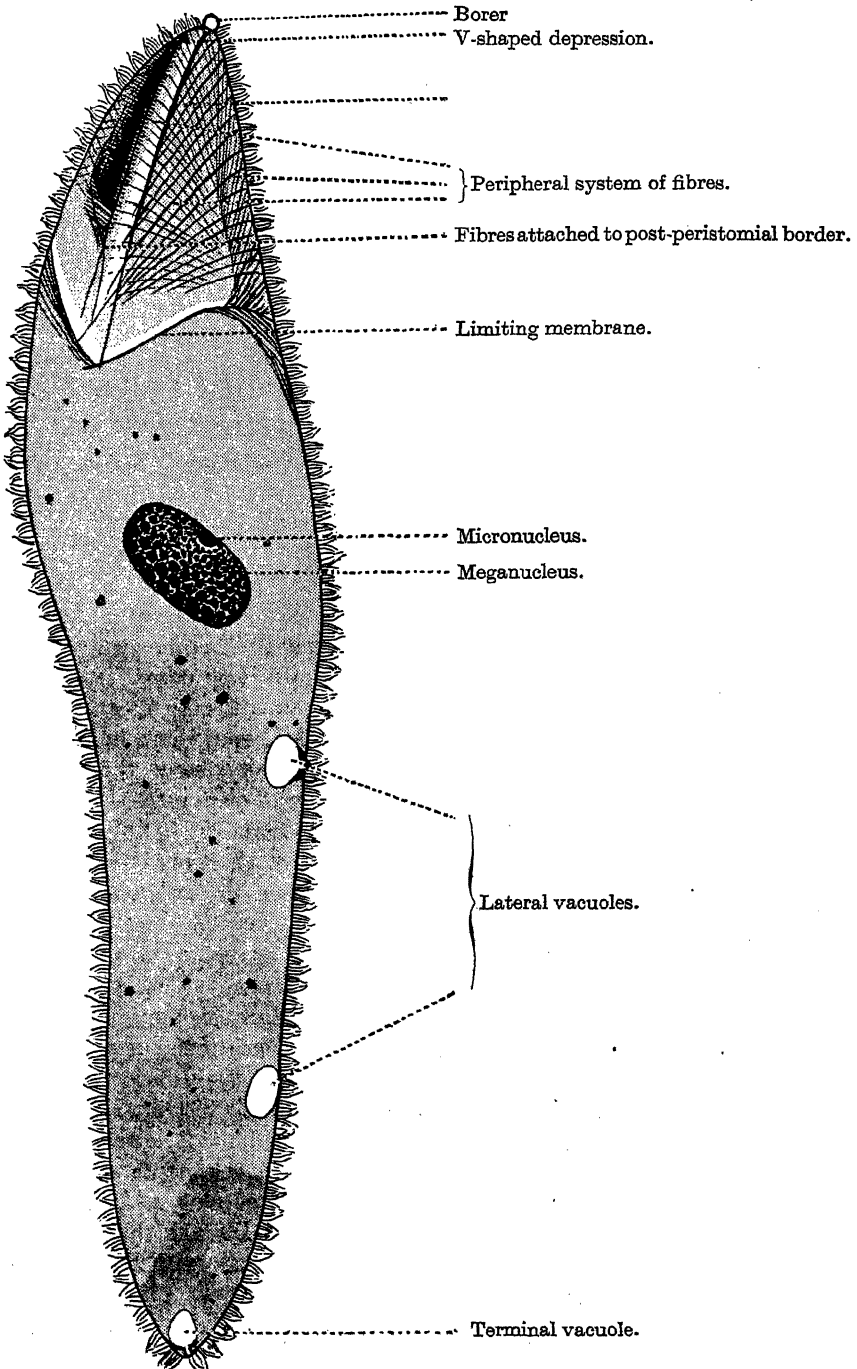


FIG. 1.—Camera lucida drawing of *B. sushilii*, made from a smear fixed in Brasil's modification of Bouin-Duboscq's fluid and stained in Heidenhain's hæmatoxylin. $\times 1200$.

TABLE I.

	<i>B. gracile</i> Bez.	<i>B. sushilii</i> n.sp.
Size	$360\mu \times 30\mu$.	$150-319.5\mu \times 35-65\mu$.*
Shape	Cylindrical.	Torpedo-shaped.
Mouth	Left peristomial wall carries long cilia; no membranelle.	Left peristomial wall carries long cilia; membranelle hangs from left peristomial wall.
Shape of the Macronucleus	Oval.	Broadly oval.
Position of the Macronucleus.	Always towards the posterior end, seldom in the middle, never in the anterior end.	Very variable.†
Position of the Micronucleus.‡	At one end of the macronucleus.	Lateral to the macronucleus.
Contractile vacuoles ..	Two; laterally placed.	Three; two lateral and one terminal.

The body is clothed with longitudinal rows of short, fine, closely set, uniform cilia. The mouth is placed slightly towards the right margin of the anterior end, the peristome beginning as a narrow groove and gradually widening as it passes backwards. To the left margin of the peristome and at a small distance behind the anterior end there is a small V-shaped depres-

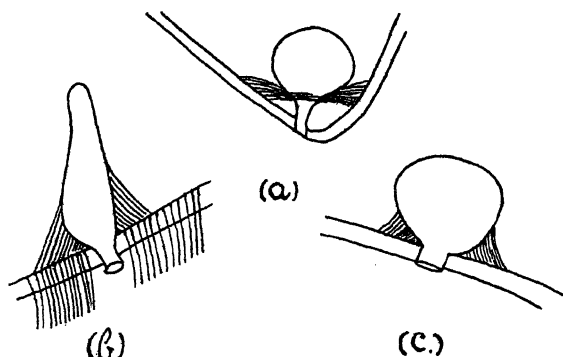


FIG. 2.—Contractile vacuoles. $\times 1620$. (a) Terminal vacuole; (b) lateral vacuole with extended fibres; and (c) with fibres contracted.

sion (see text-fig. 1). Just below the margin and along the whole length of the left peristomial wall there is a ridge beset with a row of strong large cilia, which, in a living specimen, appear to beat together and produce a current leading into the mouth. From below this row of cilia an undulating membrane hangs into the mouth cavity (see pl. I, figs. 6, 7, and text-fig. 3

* Bhatia and Gulati (2) say their specimens measure $132-210\mu \times 25-26\mu$.

† Bhatia and Gulati (2, p. 109). "We have usually found it to lie in the posterior portion, but in *one* of our specimens it lies in the anterior half of the body" [*italics are mine*].

‡ Bhatia and Gulati (2; see their fig. 9). In their specimen of *B. gracile* they have indicated the position of the micronucleus at some distance from the macronucleus.

um.). From the outer and posterior margin of the peristomial border run two short inwardly directed fibres, which gradually fade away into the cytoplasm (see text-fig. 1).

The macronucleus is broadly oval, circular in section, and its position is very variable in the body (see Table II). There is a thin nuclear membrane within which the granular nuclear material is closely packed. Nuclear dimensions range between $30\text{--}35\mu$ in length and $12\text{--}20\mu$ in breadth. Its long axis may be transverse, oblique, or parallel to the long axis of the body (see pl. I, figs. 1, 3, 4). The micronucleus is a very small round body, $2.05\text{--}3\mu$ in diameter, always placed in a depression on one side of the macronucleus. The following table gives an analysis of measurements, etc., of a number of individuals:—

TABLE II.

Size in microns.	Size of the nucleus in microns.	Position of the nucleus.	Number of contractile vacuoles.	Length of the axial system of fibres in microns.
319.44 × 65	35 × 20.5	Central.	3	45
309.66 × 60	30 × 15	Central.	3	45
290.4 × 60	35 × 15	Anterior third.	3	40
203.28 × 35	30 × 12.5	Anterior third.	3	35
203.28 × 35	35 × 15	Posterior third.	3	35
290.4 × 60	35 × 15	Extreme posterior end.	3	40
150 × 60	35 × 15	Anterior third.	3	35
290.4 × 60	35 × 15	Anterior third.	3	40
310 × 60	35 × 15	Anterior third.	3	45
315 × 65	35 × 20	Central.	3	45

The three contractile vacuoles—two lateral and one terminal—each communicate with the exterior by means of a definite opening in the pellicle (see text-fig. 2 *a, b, c*). Each lateral vacuole has fibres running from the walls of its outer half to the neighbouring pellicle. The neck of the terminal vacuole, on the other hand, is surrounded by a diaphragm of fibres running from the wall of the neck to the surrounding pellicle. A series of camera lucida drawings of sections of the organism (see text-figs. 1, 3, 4 and pl. I, figs. 6–9) will give some idea of the arrangement of the system of intracytoplasmic fibres. Study of these shows that they can be described under two heads:—

- (1) Axial system of fibres.
- (2) Peripheral system of fibres.

1. *Axial System of Fibres*.—Placed slightly towards the left of the peristome and imbedded in the cytoplasm there are three or four fibres (which in the living condition appear as a hyaline style). These fibres are either parallel, or twisted after the manner of a rope. They originate from just below the pellicle at the anterior end and extend posteriorly to a short distance beyond the mouth.



The individual fibres of this axial system gradually become thinner as they pass back; they there come in contact with the *limiting membrane* formed by the extension of some of the fibres of the peripheral system towards the mesial axis of the organism (see below). It is this structure which Bezenberger described thus in *B. gracile*, "Bei *Bal. gracile* sind sie ganz besonders stark entwickelt" (cf. fig. 13 a, u, b) . . . (2, p. 162).

In my preparations, both smears and sections, I have found a clear knob-like structure or "borer" (see text-figs. 1, 4, 5, and pl. I, fig. 5) attached at the anterior termination of these fibres by means of a short neck. This, I believe, is a device for boring through the intestinal epithelium; for often, in sections of the intestine, I have found it imbedded in the epithelium. Almost all the species of the genus *Balantidium* from vertebrate hosts are guilty of damaging the intestinal epithelium, but this is the first time that a structure for puncturing the gut wall has been noted. It is known that *Balantidium* feeds on blood corpuscles, and these, presumably,

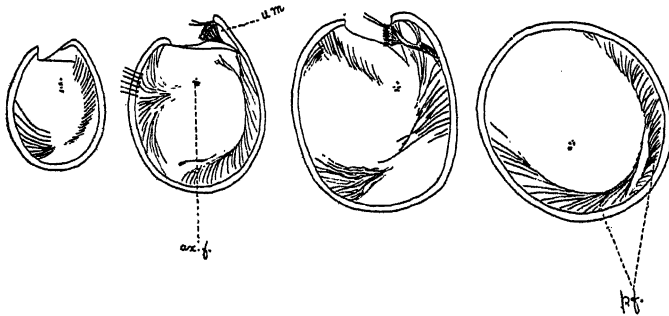


FIG. 3.—Camera lucida drawings of transverse sections of the anterior end of *B. sushilii*. $\times 600$. ax. f., axial system of fibres cut transversely; p. f., peripheral system of fibres; um., undulating membrane.

it obtains by perforating the gut wall and thereby causing the blood corpuscles to flow out through the wound. Therefore the group of fibres forming the axial system, together with the borer attached at its anterior end, may conveniently be called the *boring apparatus*.

2. *Peripheral System of Fibres*.—These are arranged in two conspicuous arches along the left anterior border of the organism. Anteriorly they send out fibres both to the right and to the left peristomial lips. Posteriorly the two arches converge, and, by prolongation of some of the fibres mesially, form a sort of *limiting membrane* (mentioned above) behind which no fibres are traceable (see pl. I, figs. 2, 4, 8, and text-figs. 1, 3, 4).

The arrangement of the fibres in *Balantidium* has been the subject of investigation by several authors, of whom Bezenberger was the first to extend his studies over several species—*B. giganteum*, *B. gracile*, *B. helence*, *B. elongatum*, *B. rotundum*. He concludes, ". . . so kann auch die von mir gefundene Insertion an den Basalkörpern nicht gegen die Myonemenatur

der hier besprochen en Fibrillen geltend gemacht werden" (2, p. 162). Investigation of living material did not carry him any further. Schneider (as quoted by Ten Kate) (4) has described the fibres as a supporting system (Stützsystem). MacDonald (3), on the other hand, holds that in *B. coli* there is a "motorium," with which the fibres are, directly or indirectly, connected. Ten Kate (5) fails to see any such arrangement in *B. entozoon*, and thinks that the fibres have a supporting function. ". . . *Bal. entozoon* eine zentrale Vereinigung fehlt und wir es hier mit verschiedenen aparten Fibrillen . . . Bei *Bal. entozoon* eine zentrale Vereinigung fehlt und wir es hier mit verschiedenen aparten Fibrillenkomplexen zu tun haben. Wenn wir die verschiedenen Fibrillen, jede für sich selbst betrachten, dann drängt sich der Gedanke einer Stützfunktion unbedingt auf" (5, p. 405). This author has also given an exhaustive review of the literature on the

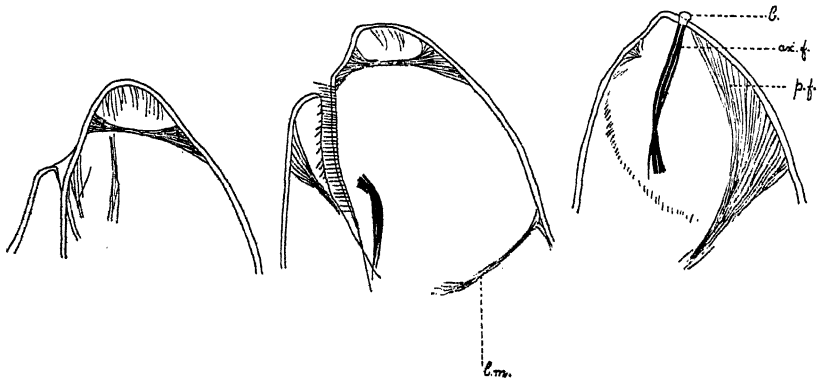


FIG. 4.—Camera lucida drawings of longitudinal sections of the anterior end of *B. sushilii*.
× 833. (b) Borer (for other letters, see explanation on fig. 3).

nomenclature of these fibres and has ultimately arrived at the following general conclusions :—

(1) Morphonemes are those fibres which maintain the body form, and may be taken as present in all ciliates.

(2) Fibres in ciliates have no connection with the neuromotor apparatus.

(3) Apparently myonemes do occur in ciliates, although in these cases the apparent contractions may be attributed to the movement of the fluid-plasma or kinoplasma.

(4) Many fibres have been wrongly referred to as myonemes.

(5) The presence of neuronemes as well as that of myophanes in ciliates is insufficiently demonstrated.

From what I have seen and described here I am rather of opinion that the peripheral system of fibres arranged in two conspicuous arches serves the purpose of maintaining the rigidity of the peristomial area, and therefore they may be termed morphonemes. The axial system of fibres, again, may be compared, as regards function, with the axostyle of some flagellates and

considered as an axial skeletal or supporting structure. In addition, this structure seems to have here the duty of supporting and guiding the borer which is placed at its anterior extremity. So here it appears that a system of fibres has adapted itself to perform a more or less specialized function. Moreover, the disposition of the axial fibres here—sometimes twisted and sometimes parallel—suggests that by their twisting and untwisting the ciliate is perhaps helped to maintain its spin round its own longitudinal

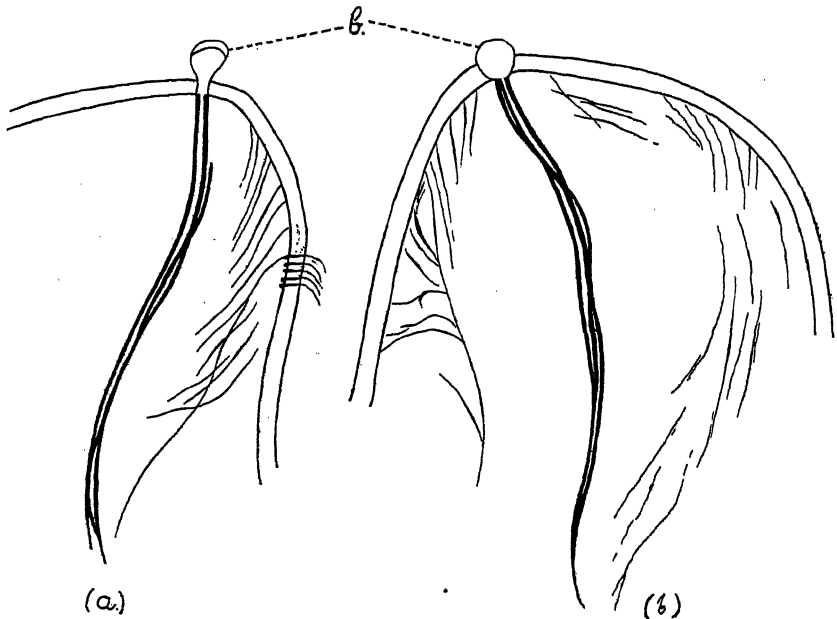


FIG. 5.—Camera lucida drawings of longitudinal sections of the anterior end of *B. sushilii*. $\times 875$. (a) Borer fully extended, and (b) same, partially retracted.

axis. Therefore, although I agree with Ten Kate that in the main the fibres are there to sustain the body form, yet it may be that the axial system in *B. sushilii* has got some sort of motor function also. Further observations are, however, necessary on these points before one can come to a definite conclusion. Perhaps a study of the effects of microstimuli on these fibres may throw some light on their properties.

4. DIAGNOSIS. *Balantidium sushilii* n.sp.

The peristome does not reach the middle of the body ; the left peristomial lip carries an undulating membrane ; the body is circular in transverse section ; there are three contractile vacuoles ; the macronucleus is broadly oval, and its position is very variable in the body ; the micronucleus is lateral to and accompanies the macronucleus ; morphonemes are arranged in two conspicuous arches at the anterior end ; a boring apparatus is present.

Size :—150-319.44 μ \times 35-65 μ .

Habitat :—Intestine of *Rana tigrina* Daud (Calcutta).

I am greatly indebted to Prof. D. L. Mackinnon of King's College, London, for kindly going through the manuscript and making helpful suggestions. My thanks are also due to my friend, Mr. M. L. Chakravarty, M.Sc., for kindly assisting me in my work in various ways.

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EXPLANATION OF PLATE.

Microphotographs of *Balantidium sushili* n.sp.†

- Fig. 1.—Microphotograph of a smear. \times 350. The ciliate on the right shows the axial and peripheral fibres; the middle one shows the ingested food granules; note the outline of the terminal vacuole in the ciliate on the left.
- Fig. 2.—The anterior end of the right-hand individual from the above group. \times 720. (Ventral view.) Note the presence of the limiting membrane and the gradual thinning out of the axial system of fibres.
- Fig. 3.—Smear. \times 720. Note the peripheral fibres and the position of the nucleus.
- Fig. 4.—Longitudinal section. \times 500. Note the limiting membrane and the position of the nucleus.
- Fig. 5.—Longitudinal section of the anterior end, showing the borer and the axial system of fibres. \times 1440.
- Figs. 6 and 7.—Transverse sections in the region of the mouth. \times 720. Note the undulating membrane and the course of the peripheral system of fibres.
- Figs. 8 and 9.—Longitudinal sections of the anterior end, showing the peripheral and axial system of fibres. \times 350.

* This paper was not available to me in Calcutta.

† I am indebted to Mr. Sachin Banerjee of the Botany Department, University of Calcutta, and to Mr. Denys Kempson, of the Zoology Department, King's College, London, for kindly helping me to take the microphotographs.

XXI.—SOME DIATOMS FROM WARRI, SOUTH NIGERIA. 582. 61.

By FREDERICK W. MILLS, F.L.S., F.R.M.S.

(Read November 16th, 1932.)

FOUR PLATES.

A SHORT time ago my friend, Mr. Sydney Chaffers, sent to me a large number of Diatom slides for identification, which he had prepared and mounted from mud collected for him by Mr. Thomas Haythornthwaite, Chief Engineer on a steamer trading with the West Coast of Africa, in a clearing in the mangrove swamp at Warri, in South Nigeria. Warri is situated in Lat. $5^{\circ} 31\frac{1}{2}'$ N., and Long. $4^{\circ} 44\frac{1}{2}'$ E., on the River Warri which joins the River Niger at Onitsba, and lies about thirty miles up the river from Forcados.

The mud consists of very fine sand, together with a very large quantity of decayed vegetable matter. When the latter has been got rid of, nothing is left but the sand, a pure gathering of Diatoms, together with a few sponge spicules.

The Diatoms from this gathering are enumerated below, and include a few new species and varieties, also known species of particular interest. The deposit contains a mixture of marine and fresh-water forms, the latter being mostly species of *Pinnularia*, amongst which are some very large and beautiful forms, and is generally of such an unusual nature that I have presumed to bring it to the notice of this Society.

The new species and varieties are illustrated as well as a few of those previously known. To these latter references are given to the original descriptions and figures, and usually a modern figure and some synonyms.

All the illustrations were drawn to the same scale and reduced on the plates to $\times 450$. They were projected on to the paper with a right-angled prism, and traced in order to correctly delineate the spacing of the markings.

In examining a large number of Diatoms from this gathering, it at once became obvious that there was a large number of intermediate forms, which it is difficult to assign to any species or variety. In the case of *Pinnularia ignota*, sp.n., the type form, which is shown in fig. 32, is quite distinct. On the other hand, there is quite a number of intermediate forms that almost connect it with *P. esox* Ehr., which latter is a very variable one in the gathering.

Species and varieties recorded :

DIATOMACEÆ.

CENTRICÆ.

DISCOIDEÆ.

COSCINODISCEÆ.

MELOSIRA Ag.

MELOSIRA (DISTANS VAR.) LÆVISSIMA Grun., V. H. Syn., pl. lxxxvi, fig. 24 ; Schm. At., pl. clxxxii, fig. 13. Small. Frequent.

COSCINODISCUS Ehr.

COSCINODISCUS DENARIUS A.S., Schm. At., pl. lvii, figs. 19-21. Small. Rare.

COSCINODISCUS HETEROPORUS Ehr., Mon. Ber. Ak., 1844, p. 265 ; Schm. At., pl. lxi, fig. 4. It is doubtful if this species can be separated from *C. Argus* Ehr. Typical. Not uncommon.

COSCINODISCUS ODONTODISCUS v. SUBSUBTILIS Rattray, Rev. Coscin, p. 486. *C. subtilis* Ehr., Schm. At., pl. lvii, fig. 14. Rare.

COSCINODISCUS JONESIANUS (Grev.) Ostenfeld, Dansk. Bot. Ark., vol. ii, no. 4, p. 13. *Eupodiscus Jonesianus* Grev., T.M.S., n.s., vol. x, p. 22, pl. ii, fig. 3. *Eupodiscus ? commutatus* and *C. commutatus* Grun., Dansk. Wien. Ak., 1884, p. 79. *C. concinnus v. Jonesianus* Rattray, Rev. Coscin, p. 532. *C. radiatus v. Jonesianus*, V. H. Treat., p. 531. Rare.

COSCINODISCUS PACIFICUS Grun., Schm. At., pl. lx, fig. 13 (identification in Index to Atlas) ; Hanna and Grant, Proc. California Acad. Sci., ser. 6, vol. xv, p. 142, pl. xvi, fig. 1. Frequent.

ACTINODISCEÆ.

ACTINOPTYCHUS Ehr. em. V. H.

ACTINOPTYCHUS FLOS-MARINA J. Brun, Esp. nouv., p. 7, pl. xi, fig. 8. Very fine and large specimens. Diam. 0.17 mm. Very common.

RADIODISCUS Bale.

RADIODISCUS CHAFFERSEI sp.n., pl. i, figs. 1, 2. Diam. 0.18-0.20 mm. Surface rising in an even curve to the almost flat centre. Rays 16-20, raised close to the margin of the valve, and thence in a straight line until they join the central hyaline space, which is stellate. The rays are furnished with rod-like processes. Apiculi numerous on the rays, diminishing in size

and number towards the central space, also on the outer portion of the valve, becoming fewer towards the centre. Angular markings cover the outer half of the rays, and the flat spaces between them, where the valve is of a yellow colour, and resembles the striæ of *Pleurosigma angulatum*.

This very beautiful and curious species appears to have for its nearest ally *Actinoptychus hispidus* Grun., in V. H. Syn., pl. cxxiii, fig. 2. W. H. Bale in J.Q.M.C., ser. 2, vol. xii, pp. 43 and 44, creates a new genus for this species, viz. *Radiodiscus*, and I accordingly place this species in that genus, and I have great pleasure in dedicating it to Mr. Sydney Chaffers, of Manchester University, at whose suggestion this paper was written, and who prepared and mounted the fine specimens on which it is founded.

EUPODISCEÆ.

AULACODISCUS Ehr.

AULACODISCUS ORIENTALIS Grev., T.M.S., n.s., vol. xii, p. 12, pl. ii, fig. 6; Schm. At., pl. xxxiv, figs. 1-3. Typical. Rare.

EUPODISCUS Ehr.

EUPODISCUS RADIATUS Bail., Smith. Centr., vol. ii, p. 39. *Aulacodiscus radiatus* (Bail.) Bright (not Grev.), Q.J.M.S., n.s., vol. viii, p. 95, pl. v, figs. 10a, 10b. Rare.

ACTINOCYCLUS Ehr.

ACTINOCYCLUS UNDATUS (Cleve.) Rattray, Rev. Actinocy. J.Q.M.C., ser. 2, vol. iv, p. 162. *A. (abienus var ?) undatus* Cleve, J.Q.M.C., ser. 2, vol. ii, p. 174, pl. xiii, fig. 14. Fine specimens. Frequent.

BIDDULPHIODEÆ.

BIDDULPHIÆ.

BIDDULPHIA Gray.

BIDDULPHIA FAVUS (Ehr.) V. H. Syn., pl. cvii, figs. 1-4. *Triceratium favus* Ehr., Abh. Berl. Ak., 1839, p. 159, pl. iv, fig. 10. Rare.

CERATAULUS Ehr.

CERATAULUS THERMALIS (Menegh.) Ralfs (not Grun.), Prit. Infus., 1861, p. 847; Forti, Contr. Diat. Atti d. R. Inst. Veneto di Sci., vol. lxix, p. 1269, pl. i, figs. 13-15, 17, 18, 21, pl. ii, figs. 4, 7, 8. *Pleurosira thermalis* Menegh., *Melosira thermalis* Menegh. (not *C. levis* v. *thermalis* Grun., Schm. At., pl. cxiv,

figs. 8-11). The specimens are very variable in size, ranging from L. 0.054-0.121 mm., B. 0.05-0.108 mm. Rare.

CERATAULUS POLYMORPHUS v. *PETITI* (Leud-Fortm.) Forti, Contr. Diat. Atti d. R. Inst. Veneto di Sci., vol. lxxix, p. 1261, pl. i, fig. 1, pl. ii, fig. 1. *C. Petiti* Leud-Fortm., Diat. de la Malaisie, Annal du Jardin Bot. de Buitenzorg, vol. xi, part 1, p. 39, pl. vi, fig. 3. Rare.

ANAULEÆ.

TERPSINOË Ehr.

TERPSINOË WARRENSIS sp.n., pl. i, fig. 3. Valve, L. 0.074 mm., B. 0.08 mm. Resembles *T. musica* Ehr. in girdle view. In valve view it is broader and is bicapitate at each end. Very rare.

HYDROSERA Wall.

HYDROSERA COMPRESSA Wall., Q.J.M.S., n.s., vol. vi, p. 252, pl. xiii, figs. 7-12; Prit. Infus., 1861, pl. vi, fig. 8. Several well-developed and typical specimens.

HYDROSERA TRIQUETRA Wall., Q.J.M.S., n.s., vol. vi, p. 251, pl. xiii, figs. 1-6; Prit. Infus., 1861, pl. vi, fig. 13; Schm. At., pl. lxxviii, figs. 36-38. *Triceratium javaniculum* Cleve, New & L.K. Diat., pl. vi, f. 75; Schm. At., pl. xciv, fig. 18. Rare.

PENNATÆ.

FRAGILARIODEÆ.

EUNOTIA Ehr. em. Grun.

EUNOTIA PECTINALIS v. *UNDULATA* (Ralfs.) Grun., in Rabenh. Beits. Kenntn. Alg., ii, p. 4, pl. i. *Fragilaria pectinalis* v. *undulata* Ralfs., Ann. Mag. Hist., vol. xii, pl. ii, fig. 3d; Schm. At., pl. cclxxi, figs. 26-28, pl. cclxxxix, figs. 26-34. *Himantidium undulatum* W. Sm., Brit. Diat., vol. ii, p. 12, pl. xxxiii, fig. 281. *E. pectinalis* v. *borealis* Grun., 1884, p. 100, pl. ii, fig. 10. *E. pectinalis* v. *bidens* A. Mayer, Denk. Bayer Bot. Ges., vol. xiii, p. 24, pl. i, fig. 49. Frequent.

NAVICULATÆ.

ACHNANTHES Bory.

ACHNANTHES INFLATA (Kütz.) Grun., Novara-Expd. Bot., i, p. 98; Boyer, Diat. Philad., pl. xvi, figs. 7, 8. *A. ventricosa* Ehr., Mikrog., p. 226, pl. i, figs. 3, 18, 19 (well drawn). *Navicula elata* Leud-Fortm. Diat. de Ceylon, pl. iii, fig. 28. *A. brevipes* v. *tumidula* Grun., Aret. Diat., p. 19.

Achnantidium in Cleve, Navic. Diat., vol. ii, p. 192; Meister, Schweitz, p. 100, pl. xiii, figs. 19, 20 (not *Stauroneis inflata* Kütz., Bacil., pl. xxx, fig. 22). Rare. PL. I, FIGS. 4-7.

COCONEIDEÆ.

CAMPYLONEIS Grun.

CAMPYLONEIS GREVILLEI (W. Sm.) Grun., Novara-Expd. Bot., i, p. 11; V. H. Syn., pl. xxviii, figs. 10-12. *Cocconeis Grevillei* W. Sm., Brit. Diat., vol. i, p. 22, pl. iii, fig. 35. *Campylodiscus Grevillei* v. *obliqua* Grun., l.c., p. 11. *Cocconeis villosa* Perag., Diat. de Villefranche, p. 38, pl. iv, fig. 35. Rare.

CYMBELLEÆ.

CYMBELLA Ag.

CYMBELLA ASPERA v. BENGALENSIS (Grun.) Cleve, Navic. Diat., vol. i, p. 176. *C. bengalensis* Grun., Schm. At., pl. ix, figs. 12, 13, pl. lxxi, fig. 79; Kitton, Linn. Soc. Bot., vol. xx, pl. xlviii, fig. 6. Frequent.

GOMPHONEMA Ag.

GOMPHONEMA ACUMINATUM v. TURRIS (Ehr.) Cleve, Navic. Diat., vol. i, p. 184; Schm. At., pl. ccxxxix, figs. 31-36. *G. turris* Ehr., Abh. Ak. Berl., 1843, p. 128. *G. apiculatum* Ehr., Mikrog., pl. ix, i, fig. 41. PL. I, FIG. 8.

FRUSTULIEÆ.

FRUSTULIA Ag.

FRUSTULIA RHOMBOIDES (Ehr.) De Toni, Syll. Alg., ii, p. 277. *Navicula rhomboides* Ehr., Abh. Ak. Berl., pl. iii, i, fig. 15, 1843; W. Sm., Brit. Diat., vol. i, pl. xvi, fig. 129. *Vanheurckia rhomboides* (Ehr.) Bréb., Ann. Soc. Phyt. Microg. Belgique, vol. i, p. 204; V. H., Syn., p. 112, pl. xvii, f. 1, 2. Rare.

FRUSTULIA INTERPOSITA (Lewis) De Toni, Syll. Alg., ii, p. 278. *Navicula interposita* Lewis, Proc. Acad. Philad., vol. xvii, p. 20, pl. ii, f. 19, 1865. Frequent. PL. I, FIGS. 9, 10.

CALONEIDEÆ.

CALONEIS Cleve.

CALONEIS FORMOSA (Greg.) Cleve, Navic. Diat., vol. i, p. 57. *Navicula formosa*, Greg. T.M.S., n.s., vol. iv, p. 42, pl. v, fig. 6; Schm. At., pl. I, figs.

9, 10, 12-15. *Navicula oregonica* Ehr., Ber. Berl., 1870, pl. ii, i, fig. 10. *N. liburnica* Grun., V. H. Syn., p. 102, pl. xi, fig. 3 (not fig. 2, which is var. *holmiensis* Cleve). Frequent, including the form shown in Schm. At., pl. 1, fig. 15.

NAVICULEÆ.

NAVICULA Bory.

NAVICULA (NEIDIUM) IRIDIS (Ehr.) Cleve, Navic. Diat., vol. i, p. 69. *Navicula iridis* Ehr., Abh. Ak. Berl., p. 130, pl. iv, i, fig. 2, 1843; Schm. At., pl. xlix, fig. 2. *Navicula firma* Kütz. W. Sm., Brit. Diat., pl. xvi, fig. 138; Schm. At., pl. xlix, fig. 3. Frequent.

NAVICULA CUSPIDATA V. AMBIGUA F. CRATICULA. *Navicula ambigua* f. *craticula* Grun., V. H. Syn., pl. xii, fig. 6. Rare.

NAVICULA PERROTETTHI Grun., M. Mic. J., vol. xviii, p. 172; Cleve, Navic. Diat., vol. i, p. 110, pl. iii, fig. 12; Schm. At., pl. cexi, fig. 33. *Craticula Perrotetthi* Grun., Novara-Expd., Bot., i, p. 20, pl. i, fig. 21. Not uncommon.

NAVICULA (SCOLIOPLEURA) TUMIDA V. ADRIATICA (Grun.) Cleve, Navic. Diat., vol. i, p. 155. *Scoliopleura adriatica* Grun., Verh., 1860, p. 554, pl. v, fig. 24. Of large size equal to *N. tumida*. L. 0.136 mm., B. 0.025 mm. Very rare.

NAVICULA (SCOLIOPLEURA ?) ALTERNANS (Schum.) De Toni, Syll. Alg., ii, p. 266. *Navicula alternans* Schum., Diat. Hohen Tatra, Verh. K. Zool. Bot. Ges. Wien, 1867, p. 72, pl. iii, fig. 48; Schm. At., pl. xlii, figs. 22, 23. Identical with Schm. At., pl. xlii, fig. 23. L. 0.103-0.109 mm., B. 0.023-0.024 mm. Uncommon.

NAVICULA PUSILLA, W. Sm., Brit. Diat., vol. i, p. 52, pl. xvii, fig. 145; Schm. At., pl. cclxii, fig. 20. Punctæ coarser than the type. L. 0.042 mm., B. 0.026 mm. Rare. PL. I, FIG. 11.

NAVICULA YARRENSIS Grun., Schm. At., pl. xlvi, figs. 1-6. L. 0.122 mm., B. 0.028 mm. Rare.

STAURONEIS Ehr.

STAURONEIS ANCEPS V. OBTUSA Grun., M.S. Cleve, Navic. Diat., vol. i, p. 148. L. 0.16 mm., B. 0.03 mm. The ends are somewhat spatulate. This variety is not illustrated elsewhere and without seeing Grunow's original specimen I feel some doubt as to the Warri specimens being correctly named by me. Rare. PL. I, FIG. 12.

PINNULARIA Ehr.

PINNULARIA INTERRUPTA F. STAURONEIFORMIS (V. H.) Cleve, Navic. Diat., vol. ii, p. 76. *P. interrupta* W. Sm., Brit. Diat., vol. i, p. 59, pl. xix,

fig. 184 (nec alibi). *N. interrupta* Schm. At., pl. xlv, figs. 72, 75, 76. *N. termes v. stauroneiformis* Grun., V. H. Syn., pl. vi, figs. 12, 13; Schm. At., pl. xlv, fig. 71. L. 0.12 mm., B. 0.03 mm. Frequent.

PINNULARIA MESOLEPTA (Ehr.) W. Sm., Brit. Diat., pl. xix, fig. 182. *N. mesolepta* Ehr., Mikrog., pl. xvii, ii, fig. 11; Kütz., Bacil., p. 101, pl. xxviii, fig. 73, pl. xxx, fig. 34; V. H., Syn., pl. vi, figs. 10, 11. L. 0.091 mm., B. 0.016 mm. Somewhat variable, but the specimens found are generally well represented by Schm. At., pl. xl, pp. 53-55. Frequent.

PINNULARIA LEGUMEN Ehr., Mikrog., pl. ii, ii, fig. 12; Schm. At., pl. xlv, fig. 45. *N. undulata*, Schum., Pruss. Diat., p. 188, fig. 37? The Warri specimens are distinctly undulate. Rare. PL. I, FIG. 13.

PINNULARIA DIVERGENS V. CAPITATA var.n., Schm. At., pl. xlv, fig. 12 (unnamed). With capitate ends. L. 0.085 mm., B. 0.025 mm. Costæ 9 in 10 μ . Common. PL. II, FIG. 15.

PINNULARIA DIVERGENS V. ELLIPTICA Grun., Fr. Jos. Land. Diat., p. 98, pl. i, fig. 19. *N. divergens*, Schm. At., pl. xlv, figs. 6, 7. Cleve (Navic. Diat., vol. ii, p. 79) makes *N. Cardinalis v. africana*, J. Brun. Esp. nouv., p. 33, pl. xvi, fig. 9, synonymous with variety. To this I cannot agree. Rare. PL. I, FIG. 14.

PINNULARIA DIVERGENS V. RUGOSA var.n. Valve linear, with slightly cuneate ends. Central area one-third of the valve, fascia narrow, a semi-circular row of dots on both sides of the central nodule. The inner margin of the costæ forms very uneven lines. L. 0.14-0.138 mm., B. 0.028-0.027 mm. Costæ 7 in 10 μ . Rare. PL. III, FIG. 29.

PINNULARIA DIVERGENS V. SCHWEINFURTHII (A.S.) Cleve, Navic. Diat., vol. ii, p. 79. *N. Schweinfurthii* A.S., Schm. At., pl. xlv, figs. 4, 5. Very variable in size. L. 0.126-0.212 mm., B. 0.032-0.048 mm. Costæ 7 in 10 μ . Not uncommon. PL. II, FIG. 16.

PINNULARIA DIVERGENS V. WARRIENSIS var.n., Schm. At., pl. xlv, fig. 3 (unnamed). Very variable in size. L. 0.140-0.128 mm., B. 0.026-0.024 mm. This variety is connected by intermediate forms with *P. Cardinalis v. warriensis* and *P. nigritiensis* (*infra*). Common.

PINNULARIA MAJOR (Kütz.) W. Sm., Brit. Diat., vol. i, p. 54, pl. xviii, fig. 162. *Frustulia major* Kütz., Syn., p. 19, fig. 25? *N. major* Kütz., Bacil., p. 97, pl. iv, figs. 19, 22. Only slightly inflated in the centre, closely approaching W. Smith's fig. l.c., which Cleve names var. *linearis*. L. 0.165-0.180 mm., B. 0.019-0.021 mm. Rare.

PINNULARIA MAJOR V. SUBACUTA (Ehr.) Cleve, Navic. Diat., vol. ii, p. 89. *P. subacuta* Ehr., Mikrog., pl. xxxv, A vi, fig. 12; Schm. At., pl. xliii, figs. 30-32. In the Warri specimens the costæ have a slightly oblique tendency. Not rare. PL. II, FIGS. 23, 24.

PINNULARIA MAJOR V. TRANSVERSA (A.S.) Cleve, Navic. Diat., vol. ii, p. 90. *N. transversa* A.S., Schm. At., pl. xliii, figs. 5, 6. L. 0.205 mm., B. 0.024 mm. Rare.

PINNULARIA EPISCOPALIS Cleve, Diat. of Finland, p. 27, pl. i, fig. 4;

Schm. At., pl. cccxii, fig. 3. *P. Cardinalis* Ehr., Mikrog., pl. xviii, i, fig. 4. Rare. PL. III, FIG. 30.

PINNULARIA HARTLEYANA Grev., T.M.S., vol. xiii, pl. vi, fig. 30; Schm. At., pl. cccxiii, figs. 1, 2. L. 0.230–0.266 mm., B. 0.030–0.037 mm. Several of the specimens have the central nodule and fascia not central, but nearer to one end of the valve than the other. Common. PL. II, FIG. 17.

PINNULARIA HARTLEYANA v. ATTENUATA var.n. Longer than the type. Axial area linear, one-third as broad as the valve. L. 0.310 mm., B. 0.037 mm. Costæ 6 in 10 μ . Rare. PL. II, FIG. 18.

PINNULARIA HARTLEYANA v. PULCHELLA var.n. Longer than the type, and more gibbous in the middle and at the ends of the valve. The costæ are also much finer. Axial area at least one-third as broad as the valve. Variable in size. L. 0.210–0.287 mm., B. 0.027–0.034 mm. Costæ 10 in 10 μ . Frequent. PL. II, FIGS. 19, 20.

PINNULARIA HARTLEYANA v. PARVA var.n. Small, slightly gibbous in the middle. Median line straight, filiform. Axial area linear, less than one-third as broad as the valve, fascia large, quadrate and uneven. L. 0.140 mm., B. 0.029 mm. Costæ 6 in 10 μ . Rare. PL. II, FIG. 21.

PINNULARIA GIBBA (Ehr.) W. Sm., Brit. Diat., vol. i, pl. xix, fig. 180; Schm. At., pl. xlv, fig. 50. *N. gibba* Grun., Wien. Verh., 1860, p. 517, pl. iv, figs. 16, 17. L. 0.126–0.142 mm., B. 0.013–0.015 mm. Rare.

PINNULARIA STAUROPTERA (Grun.) Cleve, Navic. Diat., vol. ii, p. 82. *N. stauroptera* Grun., Wien. Verh., 1860, p. 516. *N. gibba* (Ehr.) Donk., Brit. Diat., p. 70, pl. xii, fig. 3; Schm. At., pl. xlv, figs. 48–50. L. 0.118–0.129 mm., B. 0.014 mm. Rare.

PINNULARIA STAUROPTERA v. ORNATA A. Cleve, Lul. Lapp., pl. i, fig. 3. Not quite typical. Rare. PL. III, FIG. 31.

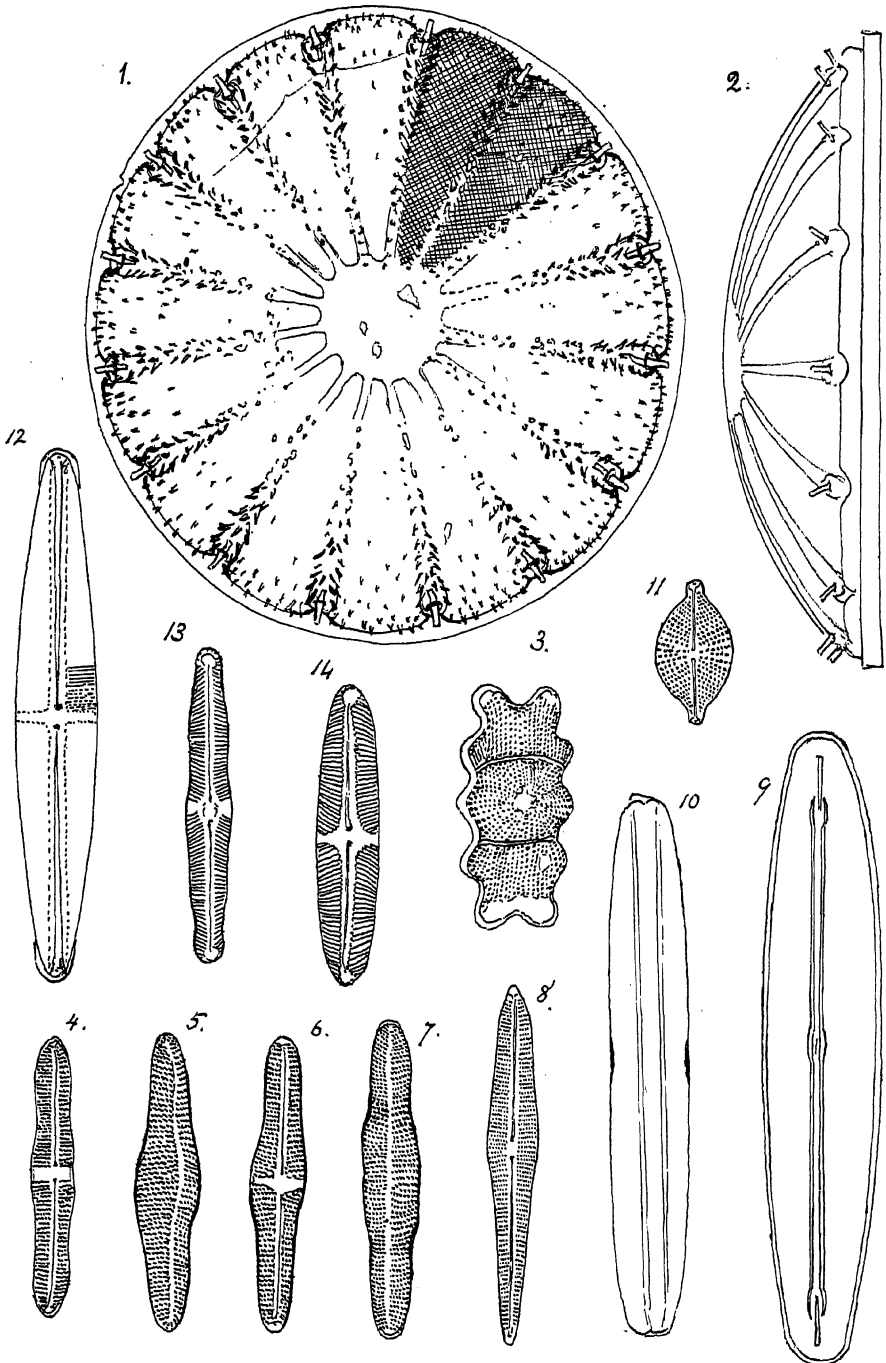
PINNULARIA STOMATOPHORA (Grun.) Cleve, Navic. Diat., vol. ii, p. 83. *N. stomatophora* Grun., in Schm. At., pl. xlv, fig. 27. L. 0.068 mm., B. 0.012 mm. Rare.

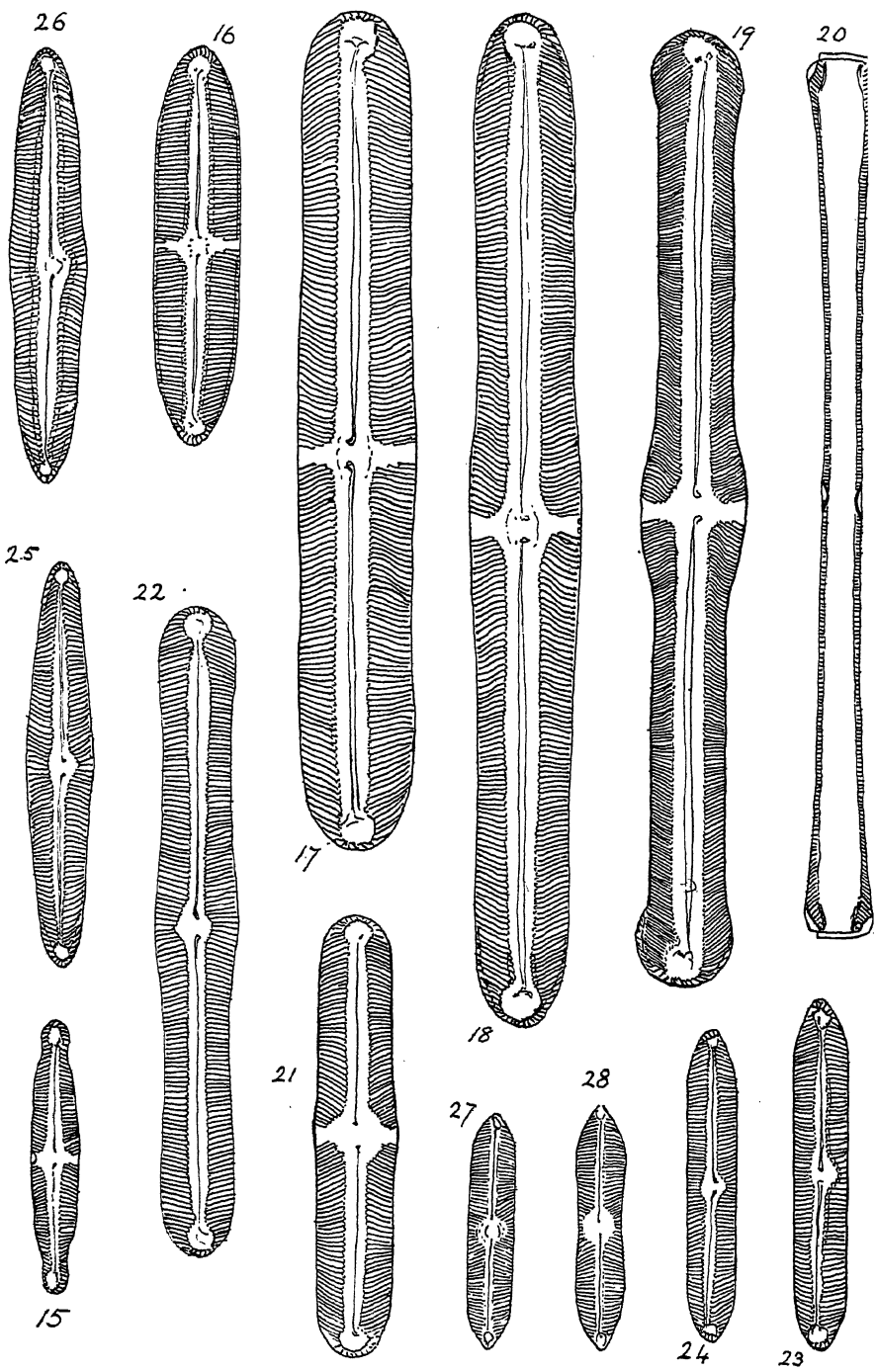
PINNULARIA ACROSPHÆRIA v. SANDVICENSIS A.S., Schm. At., pl. xliii, figs. 14, 15. L. 0.112–0.146 mm., B. 0.013–0.020 mm. Rare.

PINNULARIA CONSPICUA (A.S.) Cleve, Navic. Diat., vol. ii, p. 88. *N. conspicua* A.S., Schm. At., pl. xliii, figs. 10, 11. The valves have straighter sides than the type, and have more the outline of *N. secernenda*, Schm. At., pl. xliii, fig. 13, the sides of the valve in some cases being almost parallel. The variation from type is not, however, sufficient to warrant the creation of a new variety. L. 0.162–0.213 mm., B. 0.026–0.027 mm. PL. II, FIG. 22.

PINNULARIA ESOX Ehr., Am., pl. i, ii, fig. 4?; Cleve, Diat. of Finland, p. 24, pl. i, fig. 3. L. 0.102–0.122 mm., B. 0.021–0.027 mm. This species is very variable in outline: in some specimens it is very slightly triundulate, in others it is \pm rhomboid. PL. II, FIGS. 25, 26.

PINNULARIA IGNOTA sp.n. Valve lanceolate, inflated in the centre, cuneate at the ends. Raphe filiform, curved at the central nodule. Axial area one-third the width of the valve, narrower towards the apices. Central





portion of the area asymmetrical, usually a dot at one side of the central nodule. Costæ strongly divergent in the centre. L. 0.160–0.202 mm., B. 0.022–0.032 mm. Costæ 6–7 in 10μ . Frequent. PL. III, FIG. 32.

PINNULARIA REGINA sp.n. Valve linear, very slightly inflated in the centre, ends slightly cuneate. Median line straight. A distinct dot in each terminal nodule, central nodule bordered on each side by three or four dots. Costæ divergent in the middle, convergent at the ends, and crossed by a distinct band close to the margin of the valve, and continued round the ends. L. 0.14 mm., B. 0.02 mm. Costæ 6–8 in 10μ . Rare. PL. III, FIG. 33.

PINNULARIA IMPERATRIX sp.n. Valve linear, in the largest specimens the sides are usually slightly concave, ends rounded with a distinct sinus following the contour, from which the valve rises towards the median line, and descends to the centre where it is almost flat. Median line straight, nodules large, the central nodule surrounded by numerous large dots. Costæ crossed by a fascia, divergent in the centre. A longitudinal line crosses the costæ the whole length of the valve close to the axial area. This is probably the most beautiful of all the species of *Pinnularia*. L. 0.302–0.180 mm., B. (in centre) 0.042–0.046 mm. Costæ 6 in 10μ . Rare. PL. III, FIGS. 34, 35.

PINNULARIA INEPTA sp.n. Valve linear, with cuneate ends. Axial area narrow, central area round. Median line straight, ending in comma-shaped terminal nodules, central nodule large with a luna on each side, bordered by several dots. Costæ divergent in the middle, slightly convergent at the ends. L. 0.073 mm., B. 0.014 mm. Costæ 10 in 10μ . Rare. PL. II, FIG. 27.

PINNULARIA PASSARGEI v. *AFRICANA* var.n. Differs from the type in that the valve is more constricted in the centre, and the ends more cuneate. Axial area narrow, expanding into an almost circular space in the centre. L. 0.08 mm., B. 0.017 mm. Costæ 8 in 10μ . Rare. PL. II, FIG. 28.

PINNULARIA CHARIESSA sp.n. (*χαρίεσσα*, graceful). Valve linear, flat, very slightly inflated in the centre, ends rounded. Axial area one-third the width of the valve. Median line undulate, terminating in a large pore in the shapeless terminal nodules. A faint luna at each side of the central nodule. Costæ divergent in the centre, divergent at the ends. A delicate, but distinct species. Very common. L. 0.113–0.140 mm., B. 0.018–0.020 mm. Costæ 8 in 10μ . PL. II, FIGS. 36, 37.

PINNULARIA CHARIESSA v. *INFLATA* var.n. Valve more inflated in the centre than the type, ends cuneate. L. 0.11–0.14 mm., B. 0.02 mm. in the centre. Intermediate forms connect this with the type. Frequent. PL. II, FIGS. 38, 39.

PINNULARIA NIGRITIENSIS sp.n. Valve linear to elliptical, with rounded ends, which are very slightly inflated. Central area lanceolate expanding asymmetrically round the central nodule. Terminal nodules broad. Costæ divergent in the centre, convergent at the ends, crossed by a distinct band close to the central area. A robust species. L. 0.13 mm., B. 0.022 mm. Costæ 7–8 in 10μ . Rare. PL. III, FIG. 42.

PINNULARIA DEBSEI, Hust., Ber. Deut. Bot. Ges., 1926, p. 396, pl. v, figs. 1-5, 8. L. 0.135-0.150 mm. Striæ 6 in 10 μ . This rare and remarkable species is illustrated to show the manner of the attachment of the frustules to form a colony. Unlike *P. socialis* Palmer, they are joined together by a row of teeth respectively attached to the edges of the hoops, the teeth from either valve alternating with each other, the frustules forming a concatenate chain (as is shown in section in fig. 44), while in *P. socialis* it is the flat sides of the hoops which are in contact. The specimens from Warri were mostly conjoined in threes, while those originally discovered by Dr. Frederick Hustedt were in series of four or six. Frequent. PL. III, FIGS. 43, 44.

PINNULARIA SALEBROSA sp.n. Valve linear with rounded ends, middle very slightly inflated. Median line undulate. Axial area broad, half the breadth of the valve, widening towards the ends, then rapidly decreasing. Costæ nearly parallel, slightly divergent in the centre, forming an uneven line along the axial area. L. 0.262-0.207 mm., B. 0.032-0.025 mm. Costæ 6 in 10 μ . Frequent. PL. IV, FIG. 45.

PINNULARIA CONFRAGOSA sp.n. Valve linear with slightly concave sides, ends cuneate. Axial area at least half the breadth of the valve, except near the ends where it rapidly decreases. Median line straight. Costæ almost parallel, forming an uneven line along the axial area, and crossed by a band near the area. At the ends the costæ are depressed at each side by a sinus. L. 0.18-0.22 mm., B. 0.027-0.030 mm. Costæ 7 in 10 μ . Frequent. PL. IV, FIG. 46.

PINNULARIA DACTYLUS v. DEMERARÆ Cleve, Navic. Diat., vol. ii, p. 90; Schm. At., pl. xlii, fig. 29 (unnamed). L. 0.17 mm., B. 0.039 mm. Rare.

PINNULARIA DACTYLUS v. DARIANA (A.S.) Cleve, Navic. Diat., vol. ii, p. 90. *N. dariana* A.S., Schm. At., pl. xlii, figs. 24, 25. Rare.

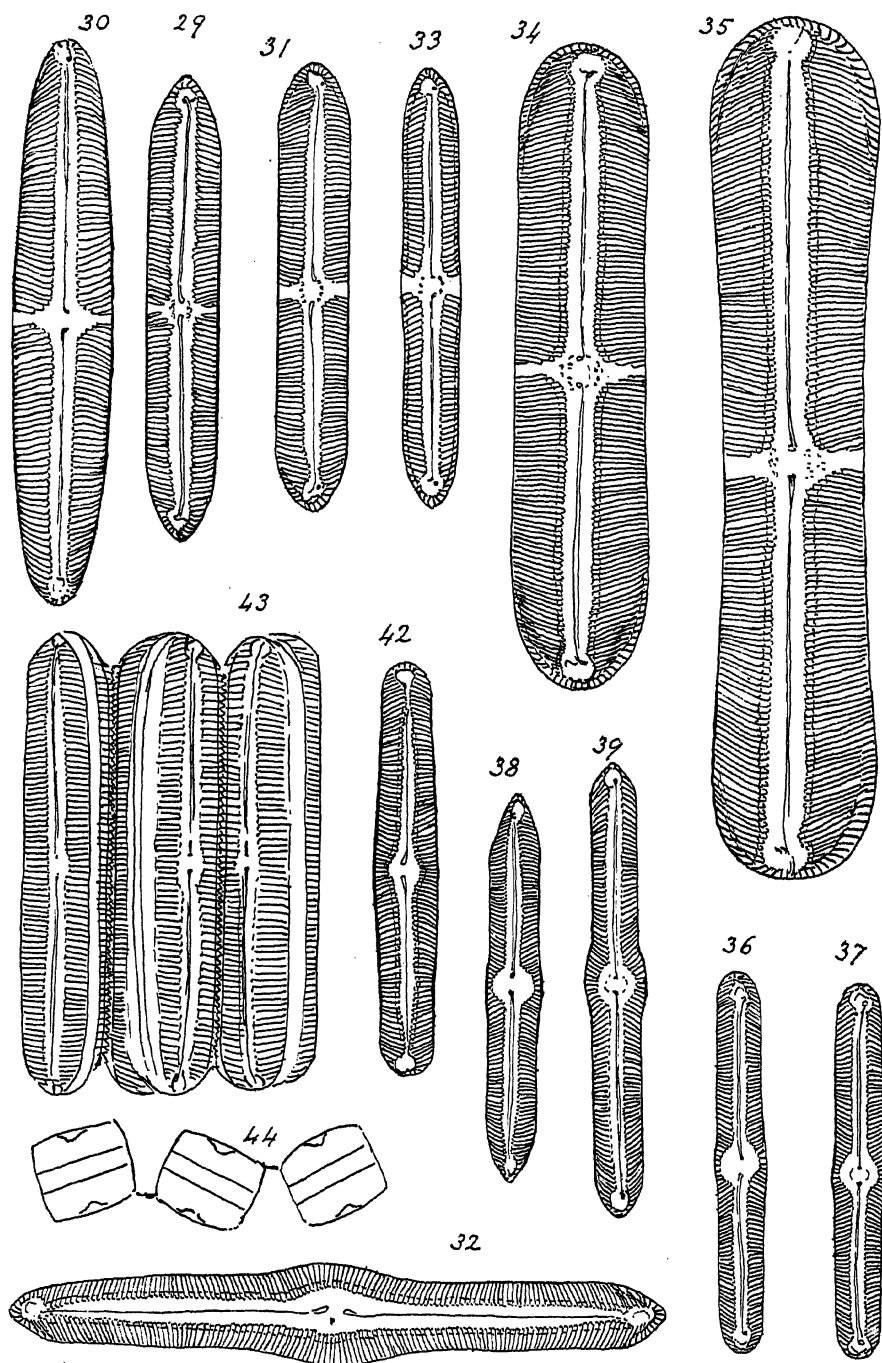
PINNULARIA VIRIDIS (Nitzsch) Ehr., Infus., p. 182. *Bacillaria viridis* Nitzsch, pl. iv, figs. 1-3. *N. viridis* Kütz., Bacil., p. 97, pl. xxx, fig. 12; Schm. At., pl. xlii, figs. 11-14, 19, 21-23 (figs. 13 and 21 being typical of the Warri specimens). Rare.

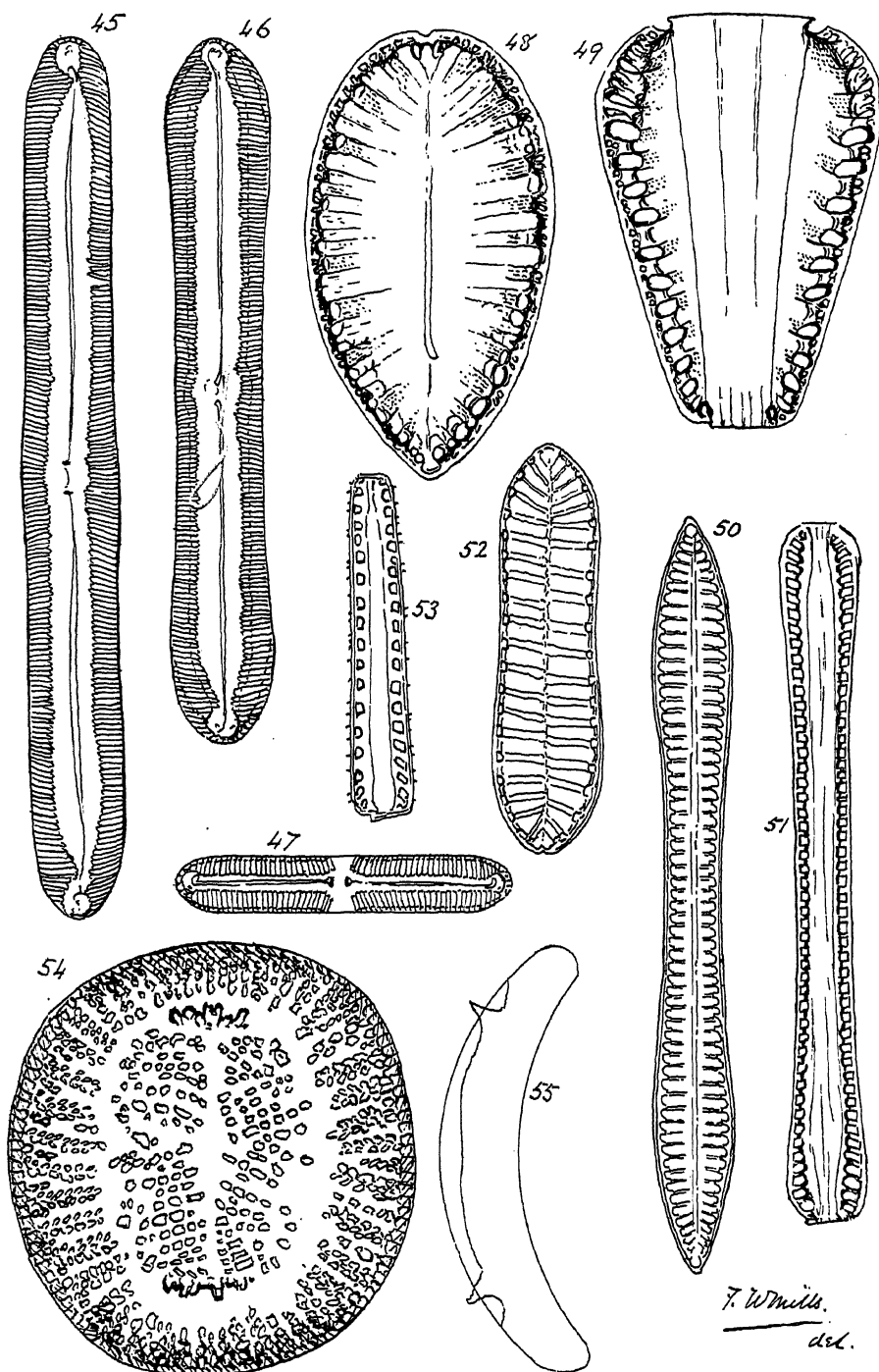
PINNULARIA VIRIDIS v. INTERMEDIA Cleve, Diat. of Finland, p. 22, and Navic. Diat., vol. ii, p. 91. *N. major* Schm. At., pl. xlii, figs. 9, 10. Rare.

PINNULARIA GENTILIS (Donk.) Cleve, Navic. Diat., vol. ii, p. 92. *N. gentilis* Donk., Brit. Diat., p. 69, pl. xii, fig. 1; Schm. At., pl. xlii, fig. 2. Rare.

PINNULARIA CARDINALIS v. WARRIENSIS var.n., Schm. At., pl. xliv, fig. 3 (unnamed). Variable in size. L. 0.128-0.190 mm., B. 0.026-0.040 mm. Common. PL. IV, FIG. 47.

PINNULARIA CARDINALIS v. AFRICANA (J. Brun.). *N. cardinalis* v. *africana* J. Brun., Esp. nouv., p. 33, pl. xvi, fig. 9. Rare.





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GYROSIGMA *Hassall, em Cleve.*

GYROSIGMA TERRYANUM (H. Per.) Cleve, Navic. Diat., vol. i, p. 114. *Pleurosigma Terryanum* H. Per., Le Diatomiste, vol. i, Supplement, p. 18, pl. vii, fig. 21. Rare.

GYROSIGMA SPENCERII v. NODIFERA (Grun.) Cleve, Navic. Diat., vol. i, p. 117. *P. nodiferum* Grun., Arct. Diat., p. 59, 1880. *P. Spencerii v. nodiferum* (Grun.) V. H. Syn., pl. xxi, fig. 13. Not rare.

GYROSIGMA BALTICUM v. SINENSIS (Ehr.) Cleve, Navic. Diat., vol. i, p. 119. *P. sinensis* Ehr., Ber., 1847, p. 485; Mikrog., pl. xxiv, vii, fig. 11. Frequent.

SURIPELLATÆ.

NITZSCHIA *Hassall, em Grun.*

NITZSCHIA BRIGHTWELLI Kitton, Prit. Infus., p. 780, pl. viii, fig. 7, 1861; Schm. At., pl. cccxxx, fig. 2. Rare.

NITZSCHIA TRYBLIONELLA Hantz. Rabh., Alg. No. 984; Cleve and Grun., Arct. Diat., p. 69, 1880; Schm. At., pl. cccxxxii, fig. 14. *Tryblionella Hantzschiiana* Grun., Verh. Zool.-Bot. Wien, vol. xii, p. 552, pl. xviii, fig. 29, 1862. L. 0.08–0.09 mm., B. 0.035–0.037 mm. Frequent.

NITZSCHIA CIRCUMSUTA (Bail.) Cleve and Grun., Arct. Diat., p. 77, 1880; Schm. At., pl. cccxxx, fig. 1. *Surirella circumscuta* Bail., Smith. Contr., vol. ii, p. 40, pl. ii, fig. 36. *Tryblionella scutellum* W. Sm., Brit. Diat., vol. i, p. 35, pl. x, fig. 74. L. 0.21–0.29 mm., B. 0.058–0.069 mm. Rare.

NITZSCHIA SIGMA v. INTERCEDENS Grun., in Schneider, Nat. Beitr. Kauk., p. 119; Schm. At., pl. cccxxxvi, fig. 5. L. 3–4 mm., B. 0.010–0.013 mm. Frequent.

SURIELLEÆ.

SURIRELLA *Turpin.*

SURIRELLA FASTUOSA v. OPULENTA Grun., Schm. At., pl. xx, fig. 1; Perag. Diat. de France, p. 248, pl. lviii, fig. 1. L. 0.098 mm., B. 0.08 mm. Rare.

SURIRELLA GUYANENSIS M. Per., in Temp. and Per., Diat. du monde entier, ser. ii, no. 251; Schm. At., pl. xxiv, fig. 25 (unnamed). Common. PL. IV, FIGS. 48, 49.

SURIRELLA VASTA Hust., Schm. At., pl. cceliv, figs. 6, 7. L. 0.127 mm., B. 0.035 mm. Frequent. PL. IV, FIGS. 52, 53.

SURIRELLA ENGLERI f. RECTA O. Müller, Nyassalande, part vii, p. 28, pl. i, fig. 4; Schm. At., pl. ccxlv, fig. 17. Common.

SURIRELLA ENGLERI v. CONSTRICTA f. SUBLÆVIS O. Müller, Nyassalande, part vii, p. 29, pl. i, fig. 9; Schm. At., pl. ccxlv, fig. 18. Common.

SURIRELLA ENGLERI v. WARRIENSIS var.n. Valve much narrower than the type, gradually constricted in the centre, with cuneate ends. L. 0.23 mm., B. in centre 0.019, at broadest part 0.07 mm. Common. PL. IV, FIGS. 50, 51.

CAMPYLODISCUS Ehr.

CAMPYLODISCUS ECHENEIS Ehr., Ber. Ak. Berl., p. 206, 1840; Schm. At., pl. liv, figs. 3-6. *C. cribrus* W. Sm., Brit. Diat., vol. i, p. 29, pl. vii. fig. 55. Diam. 0.114 mm. Several of the specimens were much corroded, and some thickened specimens were found difficult to identify. Rare.

CAMPYLODISCUS CLYPEUS v. DENTATUS var.n. Punctæ large, tooth-like, very long at the apices of the central area, which is there bent forward away from the rim of the valve, as diagrammatically shown in fig. 55. The valve is very rugged. Hyaline median area distinct, with a circular space in the centre. Not rare. PL. IV, FIGS. 54, 55.

DESCRIPTION OF PLATES.

All figures are $\times 450$.

PLATE I.

- Figs. 1-2.—*Radiodiscus Chaffersei*, sp.n.
 Fig. 3.—*Terpsinoe warriensis*, sp.n.
 Figs. 4-7.—*Achnanthes inflata* (Kütz.) Grun.
 Fig. 8.—*Gomphonema acuminatum v. turris* (Ehr.) Cleve.
 Figs. 9-10.—*Frustulia interposita* (Lewis) De Toni.
 Fig. 11.—*Navicula pusilla*, W. Sm.
 Fig. 12.—*Stauroneis anceps v. obtusa*, Grun.
 Fig. 13.—*Pinnularia legumen*, Ehr.
 Fig. 14.—*Pinnularia divergens v. elliptica*, Grun.

PLATE II.

- Fig. 15.—*Pinnularia divergens v. capitata*, var.n.
 Fig. 16.—*Pinnularia divergens v. Schweinfurtii*, (A.S.) Cleve.
 Fig. 17.—*Pinnularia Hartleyana*, Grev.
 Fig. 18.—*Pinnularia Hartleyana v. attenuata*, var.n.
 Figs. 19-20.—*Pinnularia Hartleyana v. pulchella*, var.n.
 Fig. 21.—*Pinnularia Hartleyana v. parva*, var.n.
 Fig. 22.—*Pinnularia conspicua*, (A.S.) Cleve.
 Figs. 23-24.—*Pinnularia major v. subacuta*, (Ehr.) Cleve.
 Figs. 25-26.—*Pinnularia esox*, Ehr.
 Fig. 27.—*Pinnularia inepta*, sp.n.
 Fig. 28.—*Pinnularia Passargei v. africana*, var.n.

PLATE III.

- Fig. 29.—*Pinnularia divergens v. rugosa*, var.n.
 Fig. 30.—*Pinnularia episcopalis*, Cleve.
 Fig. 31.—*Pinnularia stauroptera v. ornata*, A. Cleve.
 Fig. 32.—*Pinnularia ignota*, sp.n.
 Fig. 33.—*Pinnularia regina*, sp.n.
 Figs. 34-35.—*Pinnularia imperatrix*, sp.n.
 Figs. 36-37.—*Pinnularia chariensis*, sp.n.
 Figs. 38-39.—*Pinnularia chariensis v. inflata*, var.n.
 Fig. 42.—*Pinnularia nigritiensis*, sp.n.
 Figs. 43-44.—*Pinnularia Debsei*, Hust.

PLATE IV.

- Fig. 45.—*Pinnularia salebrosa*, sp.n.
 Fig. 46.—*Pinnularia confragosa*, sp.n.
 Fig. 47.—*Pinnularia cardinalis v. warriensis*, var.n.
 Figs. 48-49.—*Surirella guyanensis*, H. Per.
 Figs. 50-51.—*Surirella Engleri v. warriensis*, var.n.
 Figs. 52-53.—*Surirella vasta*, Hust.
 Figs. 54-55.—*Surirella clypeus v. dentatus*, var.n.

XXII.—ON THE BEHAVIOUR OF SMALL PIECES OF THE 611.018.1.
PULMONARY CAVITY WALL OF *HELIX ASPERSA*, KEPT
IN BLOOD.

By J. BRONTË GATENBY, D.Phil. (Oxon.), D.Sc. (Lond.), Professor of Zoology and Comparative Anatomy, and E. S. DUTHIE, M.B., M.Sc. (Dubl.), Rockefeller Foundation Fellow in Experimental Cytology, Trinity College, Dublin.

(Read November 16th, 1932.)

FIVE PLATES.

INTRODUCTION.

IN a preliminary letter to "Nature," December 12th, 1931, it was shown that small pieces from the pulmonary cavity wall of *Helix aspersa*, when left in hanging drops of snail blood, in the classical manner used by investigators of tissue culture, did not die immediately, but underwent a number of interesting changes which could be watched easily under the microscope.

In the material already used no aseptic precautions were taken, and though most of the preparations became contaminated by bacteria, considerable growth could be observed in many examples. Owing to the illness of the senior writer, the various problems which arose have not been investigated beyond the stage indicated in the present paper, but in view of the interest of the work it was thought advisable to record the results already obtained seven months ago.

One of the first difficulties with which we were faced was to ascertain the normal histology of the wall of the pulmonary cavity. Our friend, Mr. Robson of the British Museum of Natural History, kindly advised us as to literature, but we found that it was not easy to reconcile current accounts of the normal histology with the notions we had received in attempting to tissue culture pieces of the wall.

We were obliged to turn from the tissue culture experiments to the question of the normal regeneration of the adult snail, and so our field was widened and the problems before us became somewhat more difficult. Then, in our experiments we failed to find any mitosis of cells, and we were obliged, both from examination of sections of growing explants and direct observations of living cells, to conclude that normal mitosis was not the method of cell division in the snail when adult tissue was regenerating or growing in tissue culture.

In these days, when belief in the various aspects of the chromosome theory is almost universal, this observation presented some difficulty to us. We have been pleased to find that a German writer, L. Plate,* thirty-four years ago, claimed that in *Janella* the epithelial cells of regenerating tissues divided by amitosis.

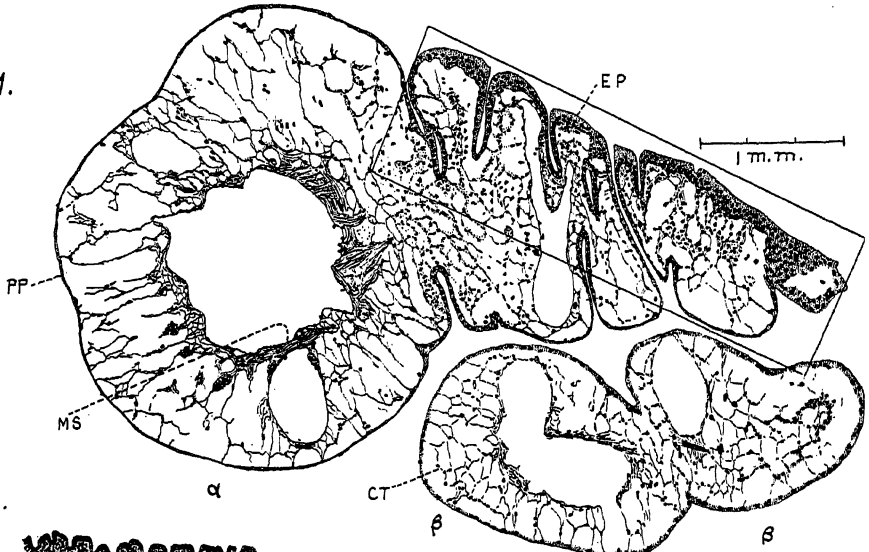
The present paper is divided into three parts. First, an account of the histology of the adult pulmonary cavity wall; then a description of the normal regeneration of the wall when cut in the living adult snail; and, finally, a preliminary account of the behaviour of the explants from the wall when left in hanging drops of blood. It is hoped that this paper may be followed by an account of the cytological behaviour of the various cells during tissue culture, but as the experiments have only recently been resumed it is not intended to go into these questions in the present communication.

THE HISTOLOGY OF THE ADULT PULMONARY CAVITY WALL.

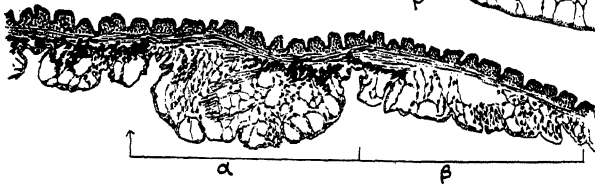
We have recognized at least nine different types of cells in the wall. First, there are the epithelial cells (EP in pl. I, fig. 3) forming a layer beneath the shell. These cells are columnar, and each one contains a distinct Golgi apparatus formed of yellow granules. In the snail, *Helix pomatia*, the pigment is absent. No basement membrane exists beneath these cells, which, as we shall see, freely wander off, both in tissue cultures and during regeneration. Immediately beneath the shell epithelium is a layer of loose connective tissue formed of small not closely packed cells, among which lie the third cell elements we have recognized. These are the so-called Leydig's pigment cells, referred to here as pigment cells (PG in pl. I, fig. 3). In this region also are to be seen many strands of muscle fibres, which appear to run in a sheet beneath the epithelium, but which in places seem to be arranged into three systems—fibres MS¹ and MS², which run in opposite directions, and the third system oblique. This arrangement is not clear in all parts of the wall, but everywhere muscle fibres are present to some degree. These then form the fourth category of cells. Then comes the main sub-epithelial body of tissue formed of loose connective cells in which lie many vesiculated cells (blasenzellen). These are, as their name suggests, rounded cells, with apparently no stainable cytoplasm, and a centrally placed nucleus. They lie in the region of the capillaries (VS in fig. 3), and constitute the fifth category of cells. Finally, beneath, there is the pulmonary epithelium (PP in fig. 3) lining the cavity itself. These cells have a more granular cytoplasm than the connective elements above. Now in addition to these six tissue elements, all of which are quite clear, there are to be seen in many examples giant cells, usually without pigment, and cubical epithelial cells lining the larger vessels, of which an example is not shown in fig. 3. We do not know whether the lining or endothelial cells of

* A number of references are given in a previous paper by the senior author, in the *Archiv für Exper. Zellforsch.* 1932.

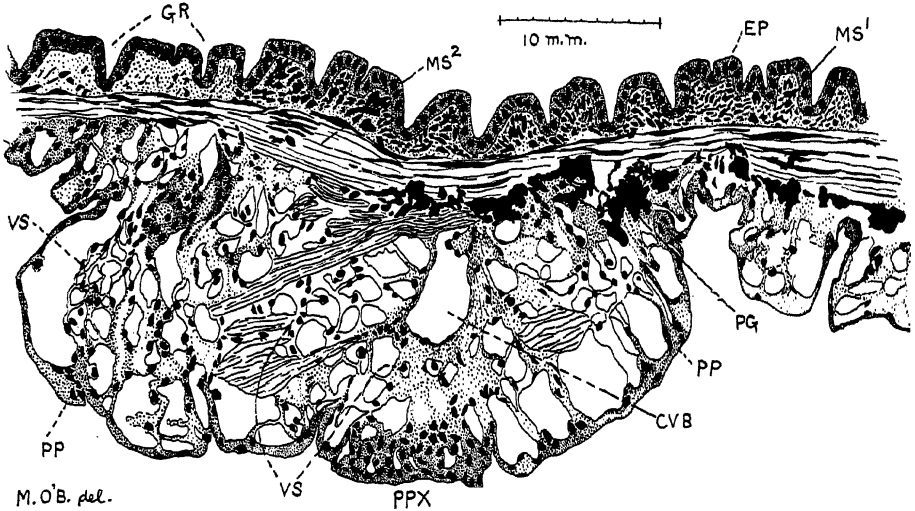
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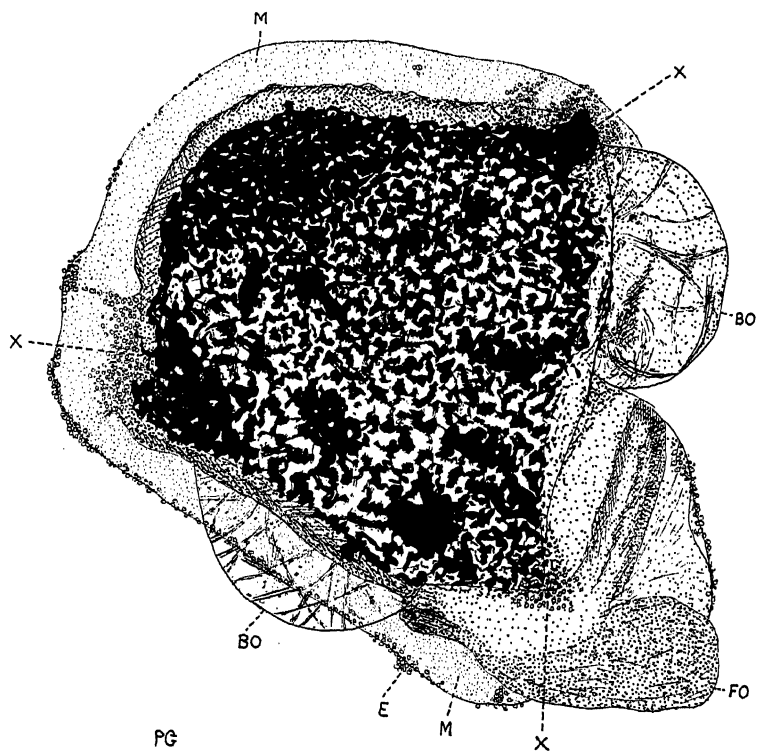
2.



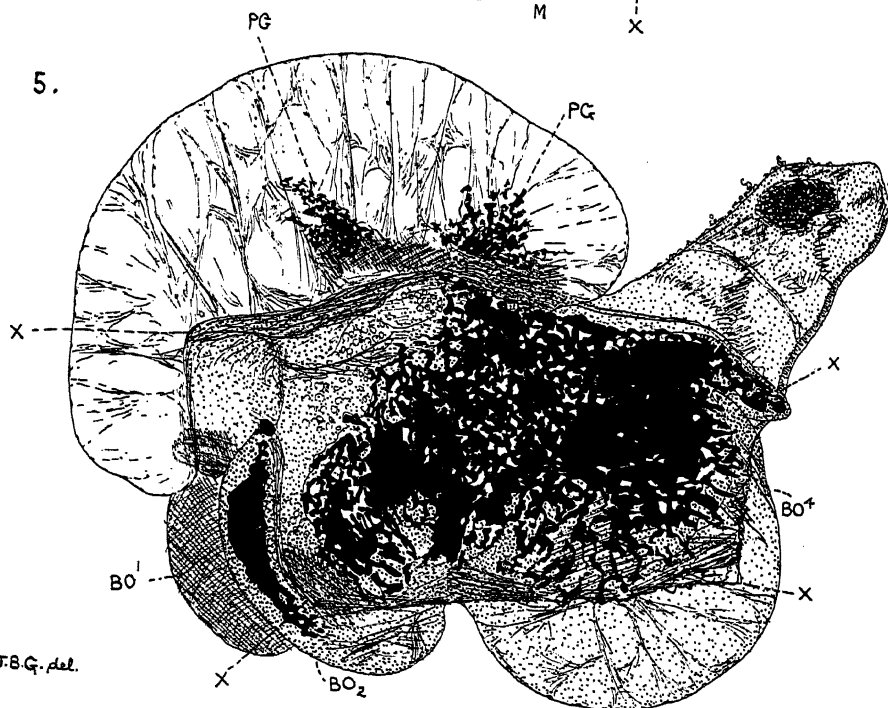
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Face p. 397.

the smaller vessels (CVB in fig. 3) are to be distinguished from the general loose connective elements which form a great part of the pulmonary wall. Possibly further investigation may solve this problem.

Besides the eight tissue elements above mentioned, special large slime glands exist here and there throughout the entire outer layer of the snail and are brought into play very actively when the shell is cracked or broken.

The blood of the snail contains numerous leucocytes of an active amoeboid nature. If the flattened wall is examined from above, or in section, it will be noted that grooves produced by folds of the shell epithelium are always present. In pl. I, fig. 3, at GR, such grooves are shown, and will be noted in all the figures in this paper which depict the epithelium of this region.

THE PROCESS OF NORMAL REGENERATION IN THE ADULT CAVITY WALL.

A number of snails were taken, and portions of the shell having been removed, small penetrating cuts were made in the wall of the pulmonary cavity. The snails were killed at intervals up to six weeks and a histological examination made of the damaged area. It was found in this manner that the regenerative power varied greatly according to the amount and location of the damage. By selecting typical specimens it was found possible to trace the stages in normal regeneration, and these are shown in figs. 11-13.

Fig. 13 is from a specimen taken 3 hours after the incision was made. One side only of the wound, which runs through a blood-vessel CVB, is shown. The section is remarkable for the great increase in the number of cells occurring at the points marked CPL. This has been produced in part by an inwandering of amoebocytes, which are especially prominent at the periphery of the mass. The central portion consists mainly of cells with large oblong nuclei, which display a parallel arrangement and are to be identified with the connective tissue elements before described. Portions of the blood-vessel wall at K show an attempt at forming the bulbous arrangement found in the cultures (pl. II, fig. 4 or 5). No mitotic divisions ever occurred, but nuclei presenting what appear to be various stages in amitosis are quite common.

Fig. 12 is from a specimen taken 24 hours after making an incision. The two edges of the wound are shown in this case, and in the right-hand edge at the point L the blood-vessel CVB appears to be closed by masses of cells similar to CPL in the previous figure. On the opposite edge, since the blood-vessel was undamaged, the incision has merely resulted in an increase in the number of cells, among which inwandering amoebocytes are prominent.

Fig. 11 shows the condition found after 15 days when union of the cut edges has occurred. The opposing borders have become united at the upper and lower points, and a very strong connective tissue union, CT, has been effected in between. This consists mainly of connective tissue cells laid in parallel bundles, with amoebocytes in between. At EPR the epidermis is reforming and consists of two or three layers of tall columnar cells, which

contain the yellow granules and are continuous with the normal epithelium on either side.

It is noteworthy that in the sequence of events described no division by mitosis was ever seen, while figures suggestive of amitosis were extremely common. The character and amount of the cell proliferation made it unlikely that very much was due to inwandering of cells. While conditions reminiscent of the bulbous formations (pl. II, fig. 4) were present in some cases, as in fig. 11, nothing of the magnitude described in the case of a culture was ever found during regeneration, so that one must conclude it is not a condition which may be produced in the living animal.

TECHNIQUE.

A description of this will be found in a previous paper* by the senior author.

The types of preparation used by us have been as follows :

No. 1 type.—The ordinary hanging drop in a hollow-ground slide, sealed with vaseline.

No. 2 type.—The same, but with another small cover-slip underneath, so that the explant is slightly compressed.

No. 3 type.—Explants left in a comparatively large amount of blood in a dish or deep hollow-ground slide.

No. 4 type.—As in type 1, but various parts of the section as shown in pl. I, fig. 3, had been excised ; for example, the layer PP (pulmonary epithelium) had been cut off.

THE HANGING DROP PREPARATION, TYPE No. 1.

In many of the preparations of type 1, the first change noted in even as short a time as 10 minutes is the stretching or prolongation down of the columns of cells just above the letters PP in pl. I, fig. 3. These columns appear to be forming the walls of capillaries, and a much later stage in the process of prolongation is shown in pl. II, fig. 5, in the area between the letters X and PG (upper). The actual columns become very attenuated, and amœbocytes may be seen actively passing down from the centre of the explant to the outer or pulmonary epithelial layer.

This process continues for many hours, till in preparations made in the day, and left overnight, one gets the appearance next morning shown in pl. II, figs. 4 and 5, and pl. III, fig. 6, where extraordinary bulbous structures are produced. In fig. 4 two outgrowths are seen at BO, and in fig. 5 there are four, three below of different sizes and the very large one above. In this and the other example shown in fig. 4, the original explant area is roughly the square or oblong part in the middle defined by the presence of pigment cells of Leydig.

In pl. I, fig. 1, is a section through a very good example exhibiting

* Archiv für Exper. Zellforsch. 1932.

the maximum amount of outgrowth shown by this hanging drop preparation of type 1. The original explant area is enclosed in a line, the main bulb coming out on the left.

While the initial stretching or tenuation of the cells in the region VS (in fig. 3) may be connected with the production of mucus, the later formation of bulbs is not so due, because the bulb is a hollow structure which pulsates freely, and which contains liquid material not mixed to a noticeable degree with mucus. In many specimens of type 1 the explant is seen to be surrounded with a layer of mucus, M, in pl. II, fig. 4. This mucus layer is not found invariably and where present seems to be due to the fact that the explant was cut from an area rich in mucous cells.

Now it is well known to embryologists that areas of great cellular activity stain deeply in the various dyes used in this branch of zoology. It is a curious fact that in the outgrowing bulbs, such as are shown in pl. II, figs. 4 and 5, BO, the stain is much denser. In pl. II, fig. 5, BO¹, which was stained in hæmatoxylin and eosin, that peculiar purple appearance which signifies cellular activity is very noticeable. There can be no mistake about this, as it is present in all examples which have been studied.

Accompanying, and keeping in front of the bulbous outgrowths, the pulmonary epithelium (PP in pl. I, fig. 3) is always present. If it is cut, it regenerates in a short time, and the whole outgrowth appears to be dominated or confined by this layer. Now the explants we have used can be likened to a tile, the glaze on the top being the shell epithelium, the main substance of the tile the bulk of cells (VS in pl. I, fig. 3), and the bottom of the tile being the layer of pulmonary epithelium, PP. The sides of the explant are, of course, free of epithelial cells of the pulmonary layer. No bulbous outgrowth is ever free from the flat pulmonary epithelial cells, and the conclusion to be drawn is that one of the first things which happens to the explant when placed in the blood drop is the spreading-over of the epithelial cells. This conclusion is also supported by examination of the natural regeneration stages depicted in pl. V, figs. 11-13, where the pulmonary epithelial cells actually penetrate into the regions where amoebocyte invasion and multiplication is in active progress.

It was also this conclusion as to the dominating activity of the pulmonary epithelium which led the senior author to make preparations in which the lower layer had been cut off with a sharp scalpel—the results of which will be reported below.

THE STRUCTURE OF THE BULBOUS OUTGROWTH.

This is shown in pl. I, fig. 1. Underneath and drawn to the same magnification is a comparable control-piece, the area cultured being marked in a line. The Greek letter, α , marks a comparable region which would produce the large bulb on the left, and β marks the smaller region on the right. Besides this, all the lower region of the original explant has grown

out to form attenuated bladder-like structures. In fig. 3 the region, *a*, comparable to that which produced the large bulb in fig. 1, left, is drawn at a higher power and has already been described previously.

Now the first question which occurs is whether there has been actual multiplication of cell elements in the metamorphosis of such an explant area as marked in pl. I, fig. 2. It is quite obvious that the cells in fig. 1 are much spun out, and that at least a great deal, if not all, of the change is due to the loosening out of the individual tissue elements. Closer examination of comparable pieces before and after culture leads us to believe that there has actually been a great deal of cell multiplication. For one thing, the area to be covered by the pulmonary epithelium has been enormously increased. It is quite true that pockets of what appear to us to be pulmonary cells exist, as at PPX in pl. I, fig. 3, and might spin out and cover a greater area, but we do not believe that such spinning out could account for the apparent multiplication of cells in this area.

The actual behaviour of each cell element of the eight categories mentioned in the description of the section in pl. I, fig. 3, have not yet been followed out by us, but some information on the more obvious points in this subject will be given below.

When touched with a needle, the bulbous outgrowths undergo a sort of peristaltic movement, and in the actual culture they usually move spasmodically when under observation. This movement is caused either by contraction of amoebocytes or by masses of muscle fibres which have migrated, or metamorphosed into the general tissue of the explant.

In some cases, especially of pieces of explant nearer the mantle cavity border, flat outgrowths of pure connective tissue (FO in pl. II, fig. 4) may be seen. These are quite different from the bulbous outgrowths.

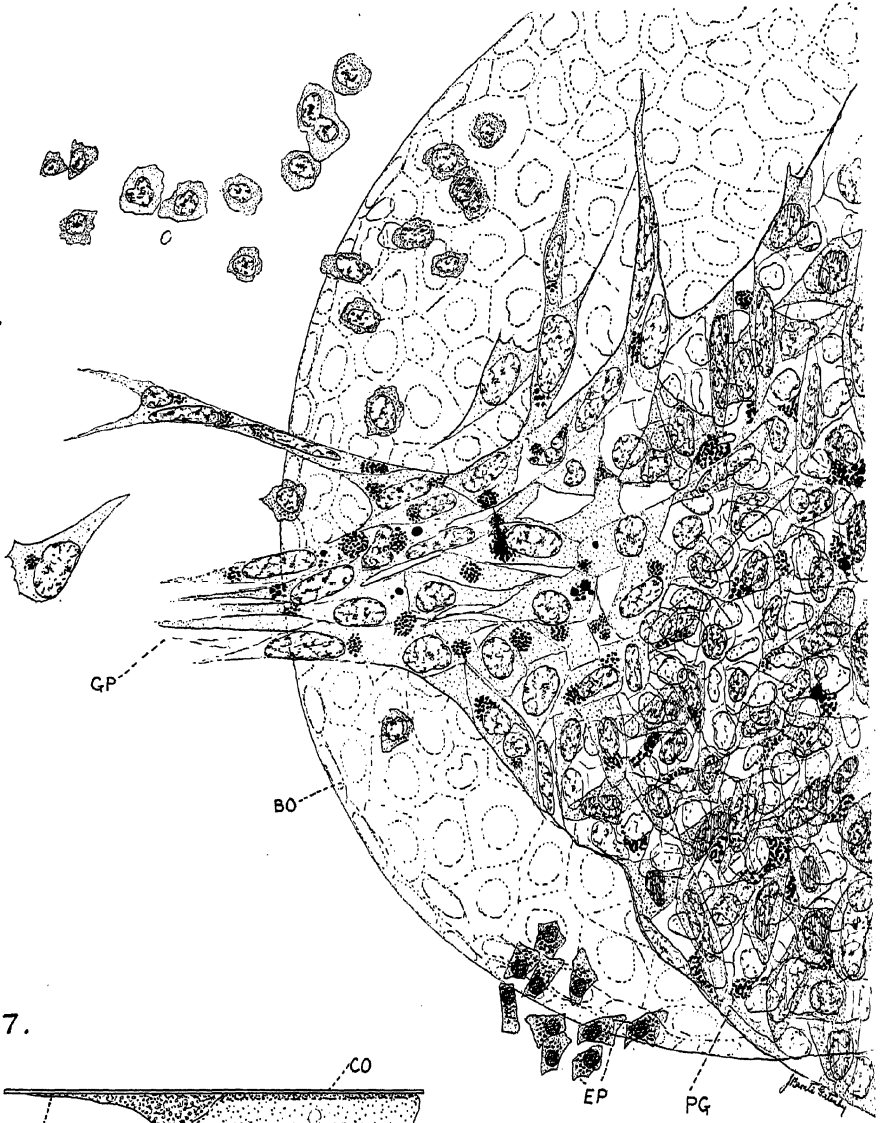
THE BEHAVIOUR OF CELLS AT THE EDGES OF THE EXPLANTS.

In pl. II, fig. 4, at X, for example, examination of those explants which adhere to the cover-slip when the preparation is fixed and stained, will show that here and there cell areas have grown out and flattened on the slide in the manner so familiar to those who have had experience of vertebrate tissue cultures.

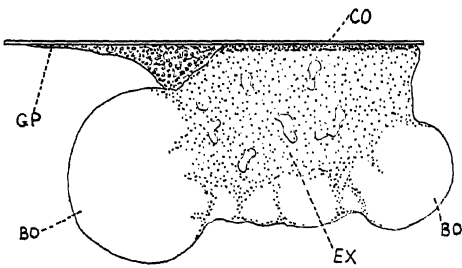
In pl. IV, fig. 8, is a preparation about 12 hours old, the migration of amoebocytes (A) and of shell epithelial cells (EP) from the underlying explant (MS) being clear. The amoebocytes have engulfed much of the pigment (P) from the pigment cells of Leydig (PG). Both classes of cells which are wandering out are adhering to the cover-slip. The shell epithelial cells wander out quite freely, but no pseudopodia have been noted on them, as is the case with the amoebocytes.

This group of cells in fig. 8 has not made any sort of coherent mass, but in pl. III, fig. 6, which is about 24 hours old, there has been considerable multiplication. In fig. 7 a profile plan of this culture is given. The cover-

6.

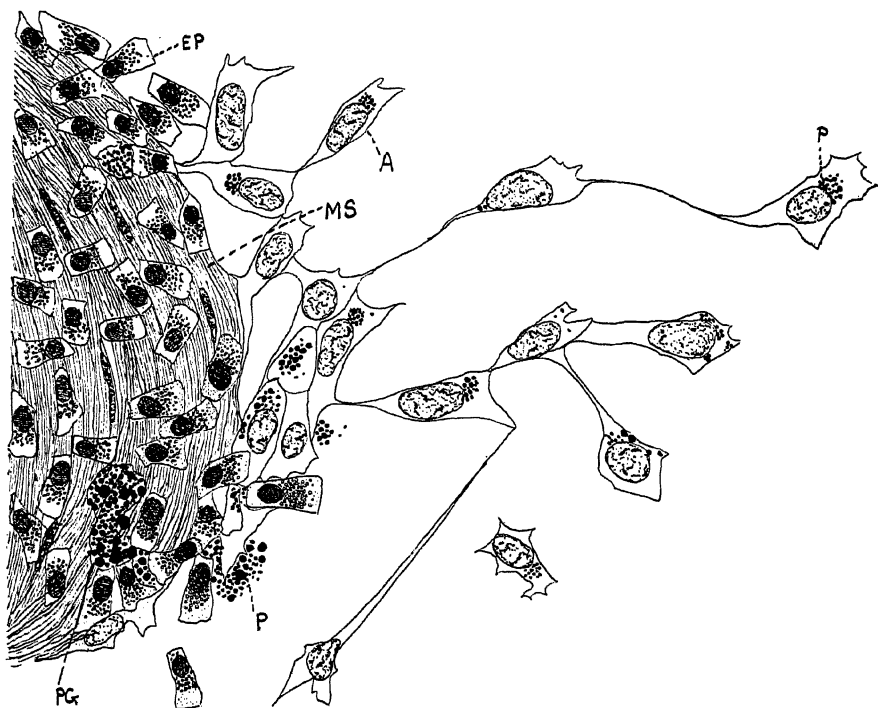


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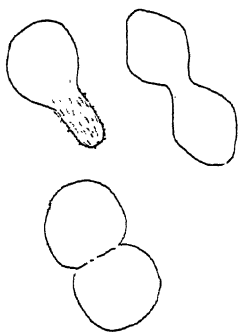


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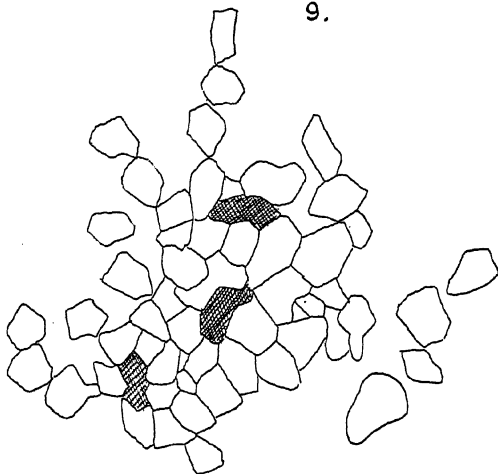
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slip is at CO, the body of the explant at EX, and at GP is a mass of cells filling in a space between the cover-slip and the explant. The point of this mass is shown in pl. III, fig. 6, from above. This is a very good example of one type of activity found in cultures from 1 to 3 days old.

The amœbocytes contain much pigment which they have ingested, and where the space between the cover-slip and the explant is deep their number is considerable. The edge GP consists of cells much flattened. At EP are numbers of shell epithelial cells, which have wandered out, adhering to the cover-slip. Below, at BO, a bulbous outgrowth is shown. This is not the only type of outgrowth which takes place; there is another variety in which there is a greater mass movement of cells. An example of this has been published in a previous paper on this subject.

THE APPEARANCE OF SHELL CRYSTALS IN TYPE 1 PREPARATIONS.

It is quite common for crystals which are unquestionably of the same nature as the shell to appear in hanging drop preparations. These appear at a distance from the explant usually somewhat greater than the coating of mucus marked M in pl. II, fig. 4. In fig. 10 examples are drawn freehand. Some are clavate, some hour-glass shaped, and others variations of these types. In fig. 9 is a camera lucida drawing of a group of crystals, the three cross-hatched spaces marking regions where the crystals are absent. In many crystals a sort of organic core can be seen, in others one end of the crystal is obviously of a different constitution, as in pl. IV, fig. 10, upper. It has been suggested to us that these crystals appear by virtue of evaporation of the blood, and are not directly connected with activity of the epithelial cells of the explant. So far as we are aware no crystals appear from blood-alone mounts, and we believe that the cells of the explant are connected with the appearance of the crystals. Further than this we have not gone at present. It should be mentioned that we have not so far found crystals in mounts of type 2.*

THE HANGING DROP PREPARATION, TYPE 2.

This is the same as before, but a small piece of cover-slip has been put under the hanging drop, so that the explant lies between the two covers, and is thereby somewhat compressed. In these, naturally, the large bulbs are absent, though smaller outgrowths occur. The main interest in these preparations is the migration of epithelial cells down, along and out of the grooves marked GR in pl. I, fig. 3, and the more normal tissue culture appearance of the edges of the explants. Aggregations of cells which can be positively identified as due to cell multiplication are much commoner. Such preparations are not illustrated in the present paper owing to the fact that we have not yet made any permanent preparations of such specimens. We

* Recently Miss J. C. Hill has found crystals formed on and around cotton wool hairs placed near the explant.

have found that they readily come away from the cover-slips, thus disturbing the appearance of the outgrowths. It appears that the closeness of the two cover-slips encourages the cells to grow out in the small space between. In the case of the shell epithelial cells, however, it is very likely that the slight pressure exerted by the capillary attraction between the two cover-slips is largely instrumental in squeezing out the cells.

PREPARATIONS OF TYPE 3.

These are explants left in deep hollow-ground slides, or in stender-dishes of blood. In our experience these are not any better than the hanging drop, type 1, and certainly not so good as those of type 2. The same bulbous outgrowths occur, but their growth never continues beyond about 3 days, even though bacteria cannot be seen actively moving in the preparation.

PREPARATIONS OF TYPE 4.

These are probably the most interesting of all. The mantle wall is cut into thin slices and each piece is turned on its side and the lower layer cut off. By this means the pulmonary epithelium is removed. Outgrowths are thus deprived of the wall (PP), and the result is a culture which looks much more like the typical vertebrate tissue culture. In such preparations large aggregations of the various cells of the main substance of the mantle cavity wall can be procured. These preparations are better when put up in double cover-slips, as in type 2.

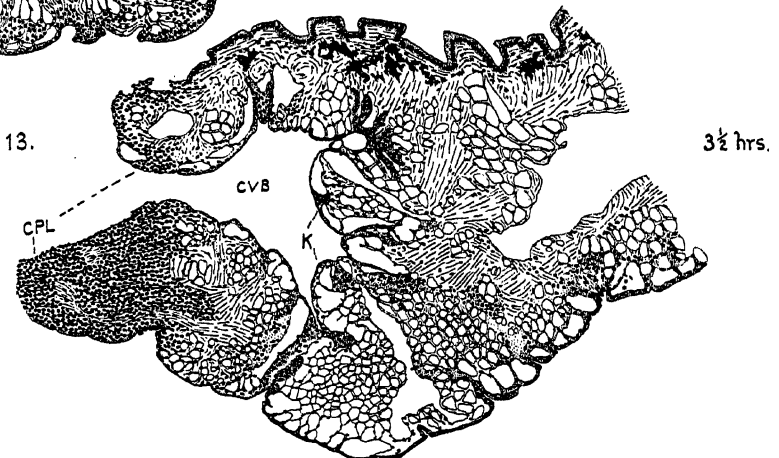
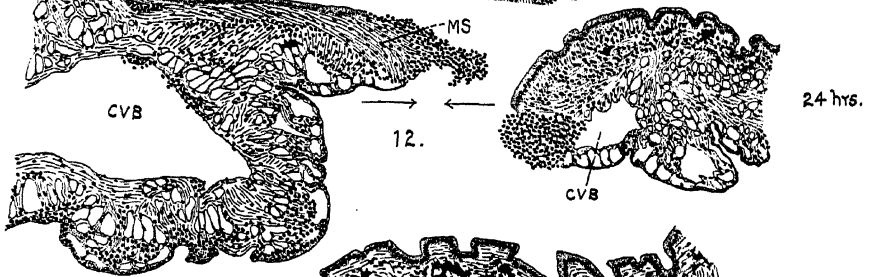
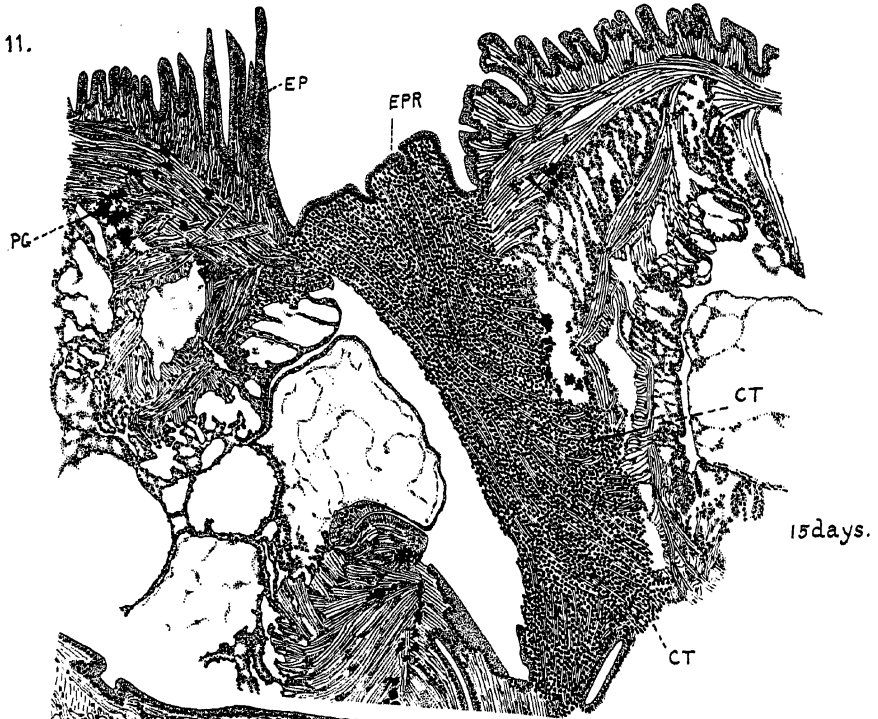
AMITOSIS IN REGENERATION AND CULTIVATION.

In any section of the normal mantle cavity wall many binucleate cells and cells with nuclei in various stages of construction are to be seen. In sections of mantle wall from half-grown snails in the summer no mitoses have been found. In no case have we seen mitoses in explants, where we believe that cell multiplication is rapidly taking place. On the other hand, even a few minutes after the explant has been placed in blood and put under the microscope, constriction and separation of cells by the amitotic method has been observed.

We have concluded that in culture and normal regeneration, and probably in normal growth as well, the cells of the snail multiply by amitosis. In the gonad, of course, normal homotypic and heterotypic mitoses exist.

DURATION OF CULTURES.

In the ordinary hanging drop preparations kept at 26-30° C. the explant continues changing for at least 3 days. In nearly every preparation bacterial infection then becomes very marked and the changes in the cells of the explant cease, and matters reach a stage when a balance between the



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resistance powers of the tissues and the toxic effects of the bacteria is brought about; gradually, however, the whole preparation becomes infected with dense masses of bacteria, and the cells begin to disintegrate. It is surprising how long such preparations will last—one such having many living cells two months after the preparation had been put up by the senior writer.

In cultures left at room temperature, the metamorphosis of the tissues of the explant proceeds slowly, and the subsequent invasion by bacteria is neither so extensive nor so potent. From a study of small explants left in a large quantity of blood, and in which bacterial invasion is either slight or not present at all, it is evident that continued mass growth, or change as such, does not go on beyond about 3 days at 26–30° C. The reason for this is unknown to us at present, and until artificial media have been prepared, and the matter further investigated, it is useless to speculate.

In any case growth in the snail must be rather slow, as holes cut in the mantle cavity of the living snail may be many weeks old before they are finally regenerated.

DESCRIPTION OF PLATES.

Lettering.

- A = amœbocytes.
- BO = bulbous outgrowth.
- CO = cover-slip.
- CPL = regenerating cut edge of mantle.
- CT = connective tissue.
- CVB = cavity of blood-vessel.
- E = migrated shell epithelial cells.
- EP = shell epithelial cells.
- EPR = regenerating shell epithelium.
- EX = explant.
- FO = flat outgrowth.
- GP = growing point.
- GR = grooves in shell epithelial layer.
- M = mucus.
- MS = muscle.
- P = broken-down pigment cell.
- PG = pigment cells of Leydig.
- PP = pulmonary (mantle) cavity epithelium.
- VS = vesicle (blasenzellen) cells.
- X = marks limits of explant and cell outgrowths in fig. 4.

- Fig. 1.—Three-day-old explant. Section. Original explant area inside lines.
- Fig. 2.—Comparable control-piece; same magnification. Greek letters α and β correspond to outgrown regions in fig. 1.
- Fig. 3.—Same as fig. 2; higher power to show some of the cell elements.
- Figs. 4 and 5.—From whole mounts of three-day-old explants.
- Fig. 6.—Edge of amœbocyte outgrowth from explant.
- Fig. 7.—Plan of fig. 6, in profile.
- Fig. 8.—Early outgrowth stage showing outwandering of amœbocytes and epithelial cells.
- Figs. 9 and 10.—Shell crystals found around explants.
- Figs. 11–13.—Sections from adult snail showing regenerating stages at 3½ hours, 24 hours, and 15 days.

OBITUARY.

ALFRED CHASTON CHAPMAN, F.R.S., F.R.M.S.

By the death of Alfred Chaston Chapman on October 17th last, at the age of sixty-two, the Society has been deprived of a distinguished Past President and a Fellow of outstanding personality.

Born in 1869, he was educated privately and at Leeds Grammar School, subsequently entering University College, London, where he took his scientific training under Williamson, Charles Graham and Carey Foster, ultimately becoming Senior Demonstrator in Applied Chemistry.

In 1888, at the early age of eighteen, he commenced practice in London as an analytical chemist in association with Prof. Charles Graham, and a little later he set up in practice on his own account in a small laboratory in Fenchurch Street—a somewhat perilous undertaking in those days. His originality, however, together with his exceptional ability, quickly established for him a growing practice in the fermentation industries, in which he became a leading consultant, and he soon moved to larger premises at 8, Duke Street, Aldgate, where he continued until his death, his laboratories occupying the whole building.

In 1899 he became Honorary Secretary of the Society of Public Analysts, which office he held until 1914, when he was elected President of that Society. In 1908 he was appointed Public Analyst to the City of St. Albans, and in the same year he was admitted to the Fellowship of the Royal Microscopical Society, of which he was elected President in 1924, which office he held for two years.

In addition to his numerous public and professional appointments, he was a member of the Court of the University of Leeds, and of the Board of Studies in Chemistry of the University of London. He was also a member of several Government committees, including the Scientific Panel of the Board of Trade, the Advisory Committee on Plant and Animal Products of the Imperial Institute, the Royal Commission on Awards to Inventors, the Forestry Products Research Board, the Chemistry Research Board, and the Government Committee on Ethyl Petrol. He was a Past President of the Institute of Brewing, and of the Institute of Chemistry, and was a Vice-President of the Royal Institution. He was also an Honorary Member of the Société de Zymologie Pure et Appliquée of Belgium, a Vice-President of



Alfred Chaston Chapman, F.R.S., F.R.M.S. 1869-1932.

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the Jury at the International Exhibition at Brussels in 1910, and Honorary Professor of the Ecole Supérieure de Brasserie, Ghent.

Chapman was a brilliant technologist and an original thinker. His many communications published in various technical and scientific journals cover a wide range in pure and applied chemistry, and his contributions to knowledge were recognized by his election to the Fellowship of the Royal Society in 1920.

For many years he cherished the idea of seeing established in England an institute of industrial microbiology, in which he conceived the Royal Microscopical Society should play an important part. This idea, to which he devoted much patient thought and labour, he gave eloquent expression to in his Presidential Address to this Society in 1926, and also in his Cantor Lectures on *Micro-Organisms and some of their Industrial Uses*, which he delivered before the Royal Society of Arts. He was convinced that such an institute, with its organized facilities for systematic research, the training of competent workers, and the preparation and supply of pure cultures, would prove of inestimable advantage and benefit to British industries, and it was his deep conviction and knowledge of the increasingly important part played by micro-organisms in modern industrial processes that led him to urge the desirability of such an establishment. It was not, however, without feelings of disappointment for him that, through the long-continued financial depression of the country, he saw but little hope of an early materialization of the object he so ardently advocated.

Chapman's absolute devotion and sincerity, together with his wide knowledge and balanced judgment, were his dominant characteristics, and he will long be remembered for his loyal support of British scientific institutions, and his sincere desire to further the practical applications of science in industry. His loss is sadly mourned.

C. T.

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ABSTRACTS AND REVIEWS.

BOTANY.

(Under the direction of A. B. RENDLE, D.Sc., F.R.S.)

GENERAL.

Cytology.

Chromosomes of *Allium* and *Nothoscordum*.—E. ANDERSON ("The Chromosome Complements of *Allium stellatum* and *Nothoscordum bivalve*," *Annals Missouri Bot. Garden*, 1931, 18, 465-68). The basic chromosome number in the genus *Allium* is 8. Root-tips of *Allium stellatum* show fourteen large chromosomes, one pair bearing satellites. Seven chromosomes are present in the pollen mother-cells, one bearing a satellite. The attachment constrictions are usually median or submedian, and meiosis is perfectly regular. Pollen-mother-cells of *Nothoscordum bivalve* have nine chromosomes, seven with median or submedian constrictions, and two with terminal constrictions. It is suggested that *Nothoscordum* may have been derived from an eight-chromosomed parental stock by the division of one of the large median-constricted chromosomes. Measurements of the chromosomes support this view. J. L.

An Unfixable Dwarf Wheat.—C. L. HUSKINS ("A Cytological Study of Vilmorin's Unfixable Dwarf Wheat," *J. Genetics*, 1931, 25, 113-24). The author summarizes the conclusions of Engledow and Wadham (1926) concerning the genetics of Vilmorin's ever-splitting dwarf wheat plants. Three main types of progeny are produced: normals, dwarfs, and pigmies. The pigmies are rare, the dwarfs and normals occur in varying ratios which approach 1:1. Cytological study has been made of three ever-splitting dwarfs, one pigmy, and three normal segregates. Forty-three chromosomes are found in the dwarfs, forty-two in the normals (typical for *Triticum vulgare*), and forty-four in the pigmy. The extra chromosome of the dwarfs is usually included in a trivalent association, but it may be a univalent, or be included in a quadrivalent or a quinquivalent. Several quadrivalent associations were found in each normal segregate. Two different lengths of chromosome are concerned. One dwarf plant was found to have an extra "short" chromosome, the two others, an extra "long" one. Since the different-sized chromosomes can pair, many different chromosomal types of progeny are possible. These differences in the proportion of "long" and "short" chromosomes within each of the three main types are probably responsible for much of the variation noted by Engledow and Wadham. J. L.

Somatic Chromosomes of the Genus *Sorghum*.—C. L. HUSKINS and S. G. SMITH ("A Cytological Study of the Genus *Sorghum* Pers. I. The Somatic Chromosomes," *J. Genetics*, 1932, 25, 241-9). The somatic chromosomes were studied in the root-tips of various species and varieties of the genus *Sorghum* within the section *Eusorghum*. A fixative "2Bd," devised by Mr. La Cour, was

found superior to older standard fixatives, and the formula for the new fixative is given. In the Johnson grass, *S. halepense*, the somatic chromosome number was found to be 40. In all other species and varieties it was 20. One peculiar-shaped chromosome can be identified in all the species examined. It is present only in duplicate in the tetraploid *S. halepense*. Frequently tetraploid areas, and in one case an octoploid area, were found in root-tips of diploid plants. J. L.

Cytological Aberrations in Wheat.—LE ROY POWERS ("Cytological Aberrations in Relation to Wheat Improvement," *J. Amer. Soc. Agronomy*, 1932, 24, 531-6). Considerable inherited variability is encountered within single varieties of wheat. The varieties used in this investigation were Marquillo, Marquis, and Minn. No. 2303, and a brief description of each is given. The chromosomal aberrations found occurring in these three varieties were: (1) micronuclei in the cytoplasm of immature pollen grains, (2) non-orientation of one or more chromosome pairs on the equatorial plane at first metaphase, and (3) non-conjunction, or the occurrence of unpaired chromosomes at first metaphase. The results show that cytological aberrations occur in greatest frequency in Marquillo, less in Marquis and still less in Minn. No. 2303. The progeny of all three varieties was investigated with regard to the following character: weight of seed, height, and percentage fruitfulness of each plant. The results show that the cytological irregularities have an important relation to the development of characters studied in the progeny in Marquillo and Marquis, but were not significant in Minn. No. 2303. J. L.

Cytology of the Cruciferae.—IRENE MANTON ("Introduction to the General Cytology of the Cruciferae," *Ann. Bot.*, 1932, 46, 509-56). Root-tips of some 250 species representing about eighty genera were examined to ascertain the effective evolutionary trends in nuclear organization, and to correlate the chromosomes with taxonomy. The formulæ of satisfactory fixatives and times of staining are given. The chromosomes are usually small, exceptions being in *Matthiola*, *Hesperis*, *Iberis*, *Bunias*, and *Menonvillea*. In *Iberis* supernumerary fragments are recorded. The fundamental chromosome numbers are 5, 6, 7, 8, 9, 11, 13, and 15; the actual somatic numbers in some species of *Crambe* reach 120. Local polyploid areas are recorded in roots of eight species. An aneuploid relationship is frequent between the fundamental numbers of genera, though rare between species of any one genus: it is usual, however, in the Brassicinae and to a less extent in the Hesperidinae. Polyploidy between species is frequent, the highest values being recorded in *Crambe*. It is suggested that there have been two distinct evolutionary processes in the Cruciferae: (1) Multiplication of Forms, and (2) Progressive Evolution. Aneuploidy appears to be frequently a positive factor in the latter process, while polyploidy, though closely involved in the former, appears often to be a barrier to true progress. A complete list of chromosome numbers is appended. J. L.

Interspecific Hybrid in Crepis.—C. F. POOLE ("The Interspecific Hybrid, *Crepis rubra* \times *C. fatida*, and some of its Derivatives. II. Two Selfed Generations from an Amphidiploid Hybrid," *Univ. Calif. Pub. Agric. Sci.*, 1932, 6, 231-55). Root-tips of plants of two selfed generations from an F_2 amphidiploid *C. rubra* \times *C. fatida* hybrid have been examined. In the first selfed generation the chromosome numbers were approximately one-half euploid and one-half aneuploid. The aneuploids were equally divided between $4n + 1$ and $4n - 1$, and the euploids equally divided between those having no rearrangements in the $4n$ set, and those showing various degrees of rearrangements. The second selfed generation from three plants of the first generation indicated that the range in chromosomal distribution was similar to that in the first. In both selfed genera

tions fertility was almost wholly confined to euploid plants. Two aneuploid $4n + 1$ plants were fertile. Each of these had, in addition to one extra chromosome, one deficient chromosome, thus balancing the additional amount of chromatin matter. Fertility never exceeded 10 p.c. even in the most fertile derivatives. This indicates that stable races are not likely to be derived from the amphidiploid. The more fertile plants of both generations had complements of an unbalanced nature. Several well-demonstrated cases of newly constituted chromosomes were observed in both generations. J. L.

Functionless Hybrid Germ Cells in Wheat.—W. P. THOMPSON and J. M. ARMSTRONG ("Studies on the Failure of Hybrid Germ Cells to Function in Wheat Species Crosses," *Canadian J. Research*, 1932, 6, 362-73). Chromosome numbers were determined in numerous male gametophytes of F_1 between 21- and 14-chromosome species of wheat. Pollen grains with various numbers from 14 to 21 are actually formed in approximately the theoretically expected proportions. Such grains with intermediate numbers are retarded in their nuclear development. Retardation is correlated with a deficiency in cytoplasmic contents, 10-15 p.c. of the grains showing little or no cytoplasm, and about 20 p.c. showing less degree of cytoplasmic reduction. All grains with reduced cytoplasm and some of those with normal contents show only one or two nuclei and no organized male cells when the normal grains are mature. They cannot therefore function with the mature ones when the stamen dehiscence. Complete abortion of some grains with intermediate chromosome numbers is seen, and retarded nuclear development in others. Only 11 or 12 p.c. of F_1 pollen grains germinate under the best experimental conditions, in contrast with 70 or 80 p.c. for parental pollen. No grains with reduced cytoplasm germinate, and at least 50 p.c. of those with apparently normal cytoplasm fail to germinate. J. L.

Origin of *Spartina Townsendii*.—C. L. HUSKINS ("The Origin of *Spartina Townsendii*," *Genetica*, 1931, 12, 531-8). From its characteristics and the circumstances in which it arose, *Spartina Townsendii* is considered to be a hybrid of *S. alterniflora* \times *S. stricta*. The material showed great difficulty as regards fixation; finally La Cour's fixative (the formula for which is given) gave satisfaction for chromosome counts. The somatic chromosome number for *S. Townsendii* was found to be 126, the highest yet recorded in the Gramineae. Seventy somatic chromosomes are present in *S. alterniflora* and fifty-six in *S. stricta*. *S. Townsendii* has evidently originated by chromosome doubling, following on interspecific hybridization. It is an extremely successful new species, having spread widely and almost eliminated its parent species when coming into competition with them. It seems justifiable to regard it as an outstanding example of the significance of allopolyploidy in plant evolution. J. L.

Haploid Japanese Morning Glory.—N. U. ("On the Reappearance of Haploid in the Japanese Morning Glory," *Jap. J. Bot.*, Tokyo, 1932, 6, 225-43). The haploid studied occurred among 300 F_1 progenies of the cross Normal \times Pine Inconstant varieties of *Pharbitis Nil*. Morphologically the plant was greatly reduced in size in all its parts. The pollen grains showed great variability in size and a high degree of abortion. Fifteen somatic chromosomes were counted in the epidermal cells of young petals. Various irregular features of meiosis are described in detail. The fifteen univalent chromosomes may pass to the poles in the following ways: 3 and 12, 4 and 11, 5 and 10, 6 and 9, 7 and 8. In many cases the distribution was made more irregular by the occurrence of laggards. Frequently binucleate pollen-mother-cells were seen. Measurements of cell size in epidermis

of stem, leaf, and corolla and of pollen-mother-cells show about 20-40 p.c. diminution from those of normal diploids. The number of pollen-mother-cells per loculus of haploid anther is also reduced. The haploid was completely sterile, but asexually propagated by grafting on sweet potato. The grafted scions showed vigorous growth. A bud mutation was observed in one of the shoots. The origin of the haploid is discussed and the suggestion made that it is due to an apomictic development of an egg caused by a particular pollen grain of the male parent. J. L.

Leaves of Healthy and "Silvered" Victoria Plum Trees.—URSULA TETLEY ("The Development and Cytology of the Leaves of Healthy and 'Silvered' Victoria Plum Trees," *Ann. Bot.*, 1932, 46, 633-52). A detailed account is given of the development of normal plum leaves from the earliest stages in the bud until maturity. The development is characterized by three main stages: (1) the meristematic stage, in which the rate of cell division is very high; (2) the stage of vacuolation and extension, during which cell division continues in the palisade layers but slows down in the mesophyll; (3) the development of the intercellular space system and acquisition of mature structure. Nuclear division in the normal leaves is described. The number of chromosomes is large, but no accurate count was obtained. There is no spireme stage, but the chromosomes separate out as definite entities from a complex network formation. The development of leaves from trees attacked by *Stereum purpureum* is compared with that of normal leaves. The chief differences are seen in the active meristematic condition. In diseased leaves many nuclei become disorganized and show a dense staining reaction; others show metaphase chromosomes clumped on the spindle and appearing to pass to either pole without separating as definite units. This degeneration of nuclei inhibits cell division in the palisade and is correlated with the subsequent separation of the epidermis from the palisade. The further development of silvered leaves is essentially the same as in normal ones, though the mature shape may be altered. The senescent changes are also similar, but occur earlier in the season and at a greater rate in silvered leaves. J. L.

Chromosome Pairing in Wheat and *Aegilops* Hybrids.—JOHN PERCIVAL ("Cytological Studies of some Wheat and *Aegilops* Hybrids," *Ann. Bot.*, 1932, 46, 479-501). Meiosis was investigated in eleven hybrids between (1) species of wheats, (2) species of *Aegilops* and wheats, and (3) species of *Aegilops*. A list of the hybrids concerned and the parental chromosome numbers is given. In all the hybrids the chromosomes are clearly defined at heterotypic metaphase and are either (1) all bivalents, (2) all univalents, or (3) some bivalents and some univalents. The bivalents are of two types, namely, (1) the acrosyndetic form in which the two component chromosomes are joined end to end in a straight line, and (2) the parasyndetic type in which the chromosomes are united in the form of a ring or broken link, or the association may be so close that the chromosomes lie side by side. The constancy of these differences suggests that they are of fundamental significance. In some of the hybrids all the bivalents are of the same type, in others both types are found, while in a third group only univalents are present at heterotypic metaphase. The results of this investigation suggest that (a) where all the bivalents are of the "parasyndetic" type the parents of such a cross belong to the same species; (b) where only acrosyndetic bivalents are found, the parents are more remotely related, being usually more marked varieties or subspecies; (c) where only univalents are observed the parents belong to different species. The prophase stages were also studied. The single leptotene threads of early prophase are considered to be half-chromosomes, their association leading to the

formation of univalent chromosomes. Both the straight acrosyndetic and ring "parasyndetic" bivalents appear to be formed in the same way, namely, by end-to-end union of whole chromosomes, which in the "parasyndetic" type are bent round, sometimes becoming joined at both ends. J. L.

Pollen-Tube Growth in *Daturas*.—J. T. BUCHHOLZ and A. F. BLAKESLEE ("Pollen-Tube Growth in Primary and Secondary $2n + 1$ *Daturas*," *Amer. J. Bot.*, 1932, 19, 604-26). The experimental conditions for making tests of pollen-tube growth in $2n$ and $2n + 1$ plants are described. Comparable tests of pollen-tube growth using the pollen of $2n + 1$ plants on styles of $2n$ plants are described and compared for twelve primaries and fourteen secondaries. The interference of extra chromosomes with pollen-tube growth differs considerably for the various chromosomes, and is independent of the size of the extra chromosomes. The causes of non-transmission of extra chromosomes through the pollen may be (1) non-germination of the $n + 1$ pollen; (2) cessation of growth and bursting of $n + 1$ pollen-tubes within the style; (3) slow growth of $n + 1$ pollen-tubes; (4) conditions intermediate between those mentioned. The results indicate that six of the twelve chromosomes of primaries are not pollen-transmissible as extras, one other chromosome might be transmitted under exceptional conditions, and five of the chromosomes of primaries may be transmitted as extras. The pollen-transmissibility of a number of the secondaries increases the list to seven or eight chromosomes which may be transmitted either directly through their primaries or indirectly through secondaries. The growth of pollen-tubes with extra chromosomes is slower than that of n pollen-tubes. Gametophytic selection greatly modifies the proportions of the $2n + 1$ types obtained in male back-crosses and may be controlled by different methods. It is possible that among the pollen grains arising from non-disjunction in microsporogenesis certain primaries might occasionally give rise to $2n + 1$ zygotes which might appear as spontaneous mutants. J. L.

Anatomy and Morphology.

Structure of *Pinoxylon dakotense*.—C. B. READ ("*Pinoxylon dakotense* Knowlton from the Cretaceous of the Black Hills," *Bot. Gaz.*, 1932, 93, 2, 173-87, 12 figs.). This fossil was originally described as having the same internal structure as *Pinus* except in the absence of fusiform rays. An examination of the types shows that the material differs in several other respects from *Pinus*, namely, in the presence of wood parenchyma, the partly araucarian character of the pits on the radial walls of the tracheids, and the abietinean character of the rays which show marginal elements markedly resembling tracheids. The wood thus shows features which relate it to both the Abietinæ and the Araucarinæ and cannot definitely be assigned to either tribe. *Protopiceoxylon* Gothan is considered to be generically identical with *Pinoxylon* Knowlton and consequently is synonymous. B. J. R.

Malayan Dipterocarpaceæ.—F. W. FOXWORTHY ("Dipterocarpaceæ of the Malay Peninsula," *Malayan For. Rec.*, 1932, 10, 1-289, 23 pls., 1 map). A full summary of existing knowledge on the trees and their products. The book is divided into sections as follows: I. Area of Country Dealt with. II. History and Present State of Knowledge. III. Family Characteristics. IV. Anatomical Peculiarities of Leaf and Petiole, Wood and Bark, including a key to the identification of the commercial timbers. V. Floral Peculiarities. VI. Germination and

Growth. VII. Distribution. VIII. Products, including Wood, Resins, Oil, Borneo Camphor, Fats and Starch, Tannin and Bark. IX. Size of Trees. X. Common Names. XI. Divisions of the Family. XII. Systematic Consideration of Genera and Species. The last section comprises the major portion of the book and covers 223 pages. The illustrations are photographs of herbarium sheets. B. J. R.

Wood Structure of Mangrove Swamp Trees.—A. J. PANSHIN ("An Anatomical Study of the Woods of the Philippine Mangrove Swamps," *Philippine J. Sci.*, 1932, 48, 143–208, 24 pls.). The results of this investigation are in agreement with Solereder's hypothesis that habitat does not impress any definite type of anatomical structure on different species, as shown by the fact that structural changes in the wood of the mangroves are not identical in different species. The following woods are described: *Cerbera manghas* L., *Xylocarpus granatum* Koen., *X. moluccensis* M. Roem., *Eccacaria agallocha* L., *Camptostemon philippense* Becc., *Heritiera littoralis* Dryand., *Sonneratia caseolaris* Engl., *S. acida* L.f., *Bruguiera conjugata* Merr., *B. cylindrica* Bl., *B. sexangula* Poir., *B. parviflora* W. & A., *Ceriops roxburghiana* Arn., *C. tagal* C. B. Rob., *Rhizophora mucronata* Lam., *R. apiculata* Bl., *Osbornia octodonta* F. Muell., *Lumnitzera littorea* Voigt, *L. racemosa* Willd., *Agiceras corniculatum* Blanco, *A. floridum* R. & S., *Avicennia marina* Vierh., *Dolichandrone spathacea* K. Schum., *Scyphiphora hydrophyllacea* Gaertn. f. The descriptions are illustrated by photomicrographs ($\times 15$ and $\times 110$) of each species and there are two keys to the identification of the woods, based on macroscopic features and on minute anatomy respectively. B. J. R.

Identification of Chinese Hardwoods.—Y. TANG ("Timber Studies of Chinese Trees. II. Identification of some important Hardwoods in Northern China by their Gross Structures," *Bull. Fan Mem. Inst. Biol.*, 1932, 3 (13), 157–210, 6 pls.). The gross structure of the wood and bark of forty-four species of twenty-four genera are described. There is a key to the identification of the genera, based on characters visible with a lens. Keys to the species are given under the descriptions of the genera. The descriptions are based on a study of a limited number of timber specimens identified from herbarium material and are illustrated by photomicrographs of cross-sections. B. J. R.

Cribriform Appearance of Pit Membranes.—I. W. BAILEY ("Preliminary Notes on Cribriform and Vestured Pits," *Trop. Woods*, 1932, 31, 46–8, 1 fig.). The punctate or sieve-like appearance of the pit membranes in the vessels of certain Dicotyledons is not due to perforations of the membranes but to minute projecting outgrowths from the free surfaces of the secondary walls. The size, form, number and distribution of the papillae vary greatly in different plants. In certain cases they are confined to the chambers of the bordered pits or to the margins of the inner and outer apertures, whereas in other cases they may occur as well in the pit canal or on the inner surface of the vessel walls. The terms *vestured pit* and *vestured walls* are proposed to describe these appearances. B. J. R.

Parallelism between Chromosome Number and Wood Anatomy.—K. SAX and E. C. ABBÉ ("Chromosome Numbers and the Anatomy of the Secondary Xylem in the Oleaceae," *J. Arn. Arb.*, 1932, 13, 37–48, 2 figs.). The natural grouping of the Oleaceae into two sub-families is indicated not only by their taxonomic characters but also by their immunological, grafting, and anatomical relationships. Of the eight genera studied, six have 23 chromosomes as the basic number, *Forsythia*

has 14 and *Jasminum* 13. The anatomical structure of *Jasminum* is closer to that of *Forsythia* than that of the other genera and it is concluded that, on the whole, there is a suggestive parallelism between chromosome number, grafting relationships, and anatomical structure.

B. J. R.

Laticiferous Cells in *Beaumontia grandiflora*.—R. H. WOODWORTH ("Diaxylyary Laticiferous Cells of *Beaumontia grandiflora*," *J. Arn. Arb.*, 1932, 13, 35-6, 1 pl.). The distribution of latex cells in the phloem, xylem, and pith of *Beaumontia grandiflora* Wall., an East Indian member of the Apocynaceæ, is described and figured. When the tissues are differentiating behind the growing point some of the latex cells work across the procambial region. Cells adjacent to a latex cell are affected so that they remain parenchymatous and when passing radially across the xylem a latex cell is surrounded by parenchyma cells in the form of a ray.

B. J. R.

Anatomy of the Alismataceæ.—FRITZ JÜRGEN MEYER ("Beiträge zur Anatomie der Alismataceen," *Beihefte Bot. Centralbl.*, 1932, 49, 309-68, 23 figs.). In this paper, which is intended to be the first of a series describing the systematic anatomy of the Alismataceæ, the author deals in great detail with the anatomy of *Echinodorus macrophyllus* (Kunth) Micheli, and other species. Anatomical features of the genus as a whole are first described, and after this characters by which the species may most easily be distinguished from one another are considered. Amongst these may be mentioned: (1) The presence or absence and shape of the absorbing cells (Hydropoten) on the submerged portions of the leaf. (2) The distribution and shape of the trichomes. (3) The shape of the cells of which the diaphragms, present at intervals as interruptions of the lacunæ present in the leaf-stalks, are composed. (4) The distribution of the latex canals. (5) The presence or absence of a zone of fusion of the vascular system at the junction of the lamina and petiole. In some instances anatomical support was afforded to botanists, who, on purely morphological grounds, had subdivided pre-existing species. In some instances also marked anatomical differences were found between varieties of a single species, but this was not so in all cases. In *Echinodorus ranunculoides* forma *zosterifolius* there were found to be anatomical differences between the upper third and the lower two-thirds of the ribbon-leaves. Comparisons were made between forma *ranunculoides* and forma *typicus*, and it was concluded that in the ribbon-leaves the lower two-thirds represents the petiole and the upper third the lamina. No definite correlation was established between the geographical distribution of the species and their possessing distinctive anatomical characters according to the region where they grow.

C. R. M.

Underlying Causes of the Structure of Roots.—LUDWIG JOST ("Die Determinierung der Wurzelstruktur," *Zeitsch. f. Bot.*, 1932, 25, 481-522, 10 figs.). A discussion of such problems as the reason why apparently similar cell-groups may, during their development, give rise to such unlike structures as roots, stems, and leaves respectively; or why the cells cut off by the cambium of a vascular bundle should on one side give rise to vessels and on the other to sieve tubes. The author considers that the mode of differentiation of the cellular body may be due either to small quantities of growth controlling substances present in the tissues, or, alternatively, that the mode of growth is determined by differences inherent in undifferentiated cellular material. The first of these alternatives is thought to be the more probable one in the light of experiments with decapitated roots of *Vicia Faba* and *Zea Mais* carried out by the author.

C. R. M.

Supplementary Growth in Thickness of Contractile Roots of Monocotyledons.—A. RIMBACH ("Nachträgliche Dickenzunahme kontraktile Monokotylen Wurzeln," *Ber. Deutsch. Bot. Ges.*, 1932, **50**, 215-9, 1 fig.). Contractile roots of the Monocotyledons are of two types. In one of these growth in thickness is completed in the region immediately behind the root-apex where growth in length takes place. As soon as the capacity to grow in length is lost, growth in thickness ceases forthwith. In the second type the tissues at the growing point retain their capacity to grow in thickness after they have passed out of the region where growth in length takes place. Details of the growth in thickness of a number of genera are given. Growth in the roots of certain Dicotyledons, e.g. *Ranunculus Bonplandianus*, *Stachys elliptica*, *Werneria disticha*, etc., is stated to proceed in the same way as in the Monocotyledons. C. R. M.

Physiology and Anatomy of some Indian Halophytes.—D. P. MULLAN ("Observations on the Biology and Physiological Anatomy of some Indian Halophytes," *J. Ind. Bot. Soc.*, 1932, **11**, 103-18, 6 pls.). Anatomical descriptions of *Rhizophora mucronata* Lamk., *Ceriops Candolleana* Arn., *Bruguiera caryophylloides* Blume and of their viviparous seedlings are given. Most of the features described have been observed by previous workers in the same or closely related species. C. R. M.

Influence of Light Intensity and Soil Moisture on the Anatomy of the Castor Bean.—W. T. PENFOUND ("The Anatomy of the Castor Bean as conditioned by Light Intensity and Soil Moisture," *Amer. J. Bot.*, 1932, **19**, 538-46, 5 figs.). The average diameter of the root of castor beans as well as the area of the xylem as seen in transverse sections varies in direct proportion to the light intensity and soil moisture. This is true also of the cross-sectional area of the xylem and other vascular tissues, as well as of the size of the cells and the thickness of the wall of the mechanical elements in the stem. In leaves the number of stomata per unit area, the extent to which the mesophyll and midrib respectively developed were favoured by maximum illumination and high water content of the soil. The ratio of the vascular area of the stem to the leaf area was greatest under maximum conditions of illumination, but varied little with the amount of soil moisture. Nevertheless, the ratio of the average transpiration per plant either to the xylem or vascular area was similar under different intensities of illumination but varied in proportion to the amount of soil moisture. C. R. M.

Development of Pine Seedlings.—G. BRUNNER ("Beiträge zur Entwicklungsphysiologie der Kiefernkeimlinge," *Jahrb. Wiss. Bot.*, 1932, **76**, 407-40). Most of this paper is concerned with the physiology of the development of pine seedlings, but the anatomy of the mature seed and of the embryo at different stages of its development are briefly described. The author's main conclusion is that the course of development of the embryo is governed by the endosperm. For development to proceed normally it is necessary for the endosperm to be present undamaged. If the whole endosperm is removed experimentally development of the embryo proceeds abnormally. When the endosperm is partly removed the growth in length of the seedling is curtailed, and the production of roots ceases. C. R. M.

Embryology of *Chamaecyparis obtusa*.—J. T. BUCHHOLZ ("The Embryology of *Chamaecyparis obtusa*," *Amer. J. Bot.*, **19**, 3, 230-8, 7 figs.). The embryology in *Chamaecyparis*, *Biota*, and *Libocedrus* is very similar. Cleavage polyembryony occurs in all forms, and is thought to be characteristic of the Cupressineae

as a whole. In *Chamaecyparis* the embryos are sometimes borne on primary suspensors, but in other instances they are formed by a proliferation of some of the prosuspensor cells. The individual embryos become multicellular by divisions of an apical cell. The chief difference between the embryo-systems of the Taxodineæ and the Cupressineæ is that from the first of these groups a primary suspensor is usually absent. A discussion deals with the probable lines of evolution of the different types of embryology so far recorded for the Cupressineæ, Taxodineæ, and other related groups.

C. R. M.

Embryology of *Daphniphyllum macropodum* Miq.—M. VENTURA ("Ulteriori osservazioni sull'embriologia di *Daphniphyllum macropodum* Miq.," *Annali di Bot.*, 1932, 19, 550-3). The development of the albumen is parthenogenetic and independent of the stimulus of pollination while the development of the embryo is parthenogenetic but dependent on the stimulus of pollination. Lack of fertilization is due to degeneration of the nuclei of the pollen grains after the latter have attained complete development.

A. W. E.

Vascular System of Orchid Seedlings.—E. FRANCINI ("Lo sviluppo del sistema vascolare nelle piantule di alcune Orchidaceæ," *Nuov. Giorn. Bot. Ital.*, 1932, 39, 226-42, 24 figs.). The species investigated were *Bletilla hyacinthina* Reichb. f. and three species of *Paphiopedilum*, in all of which seedlings can be obtained without infection by an endophytic fungus by employing concentrated solutions of organic substances. The embryo of *B. hyacinthina* is rudimentary compared with monocotyledons in general though much more differentiated than in most Orchidaceæ. Development takes place by the formation of successive phyllorhizes, each being a morphological unit formed of two parts, a leaf and a root. The first phyllorhize, normally already formed in the embryo, consists in *B. hyacinthina* of the cotyledon and a rounded body, the protocorm. This primary phyllorhize is not completely laid down in the embryo and never attains complete development. A well-developed conducting system is only present in the upper part of the protocorm, the basal portion consisting of parenchyma. The second phyllorhize has, however, a complete conducting system. In *Paphiopedilum* the embryo is much more rudimentary, the first phyllorhize being devoid of conducting tissue, apart from a few vestigial elements in the cotyledon. Sometimes even the second leaf has no vascular tissue and may lack its corresponding rootlet. It is suggested that a reduction of successive phyllorhizes is general in the Orchidaceæ and that the process of reduction is typically basifugal.

A. W. E.

Anatomy and Development of the Foliar Embryos of *Bryophyllum calycinum*.—JOHN A. YARBROUGH ("Anatomical and Developmental Studies of the Foliar Embryos of *Bryophyllum calycinum*," *Amer. J. Bot.*, 1932, 19, 443-53, 2 pls.). An account of the development of the foliage leaves of *Bryophyllum calycinum*, and of the foliar embryos that arise from meristematic cells in the leaf notches. Foliar embryos sometimes arise also in the bracts of the inflorescence. The embryos develop into plantlets only if they are uninjured. Patches of meristematic cells, whose significance was not determined, but which were unrelated to the development of the foliar embryos, were also observed at the apex of the leaf crenations.

C. R. M.

Morphology and Anatomy of Hygroscopic *Mesembryanthemum* Fruits.—S. LOCKYER ("Seed Dispersal from Hygroscopic *Mesembryanthemum* Fruits, *Bergeranthus scapigerus* Schw., and *Dorotheanthus bellidiformis* N. E. Br., with a note on *Carpanthea pomeridiana* N. E. Br.," *Ann. Bot.*, 1932, 324-42, 24 figs., 1 pl.).

An account of the anatomy and morphology of *Bergeranthus scapigerus* Schw., and *Dorotheanthus bellidiformis* N. E. Br. and experiments on their mode of dispersal. The fruits of both species are five-valved capsules which open when made wet by rain and close again on drying.

C. R. M.

Stomata of *Vaccinium macrocarpon*.—W. H. SAWYER ("Stomatal Apparatus of the Cultivated Cranberry, *Vaccinium macrocarpon*," *Amer. J. Bot.*, 1932, 19, 508-13, 1 pl.). No taxonomic or functional differences were observed in stomata of four cultivated varieties of *Vaccinium macrocarpon*. Stomata, which occur only on the lower surface of the leaf and contain no chloroplasts in the guard cells, were present on an average to the extent of 632 per sq. mm. No differences were noted between the stomata of *V. macrocarpon* and those of *V. corymbosum*.

C. R. M.

Variations in the Floral Structure of *Stellaria media*.—EDWIN B. MATZKE ("Flower Variations and Symmetry Patterns in *Stellaria media* and their Underlying Significance," *Amer. J. Bot.*, 1932, 19, 477-507, 119 figs.). An account of variations noted in the floral structure of *Stellaria media* sub-sp. *neglecta*, var. *typica* Beguinot. When petals are present, or when normal stamens are replaced by petals, this occurs most frequently in one particular position in the flower. It is usual for this variety of *Stellaria media* to possess ten stamens, but all stages intermediate between this and flowers having as few as two stamens were observed, in some instances flowers with two to ten stamens being observed on one individual plant. "The occurrence of supernumerary petals, as well as the disappearance of the stamens, have been considered from the standpoint of a possible original 'spiral' arrangement within the flower." Approximately bilaterally or radially symmetrical flowers were found to be more common than those that were wholly asymmetrical. The position of the carpels was slightly different from that recorded by previous workers.

C. R. M.

Tertiary Pollen.—R. P. WODEHOUSE ("Tertiary Pollen. I. Pollen of the Living Representatives of the Green River Flora," *Bull. Torr. Bot. Club*, 1932, 59, 313-40, 3 figs., 3 pls.). Palaeobotanists are frequently unable to identify pollen grains preserved in tertiary deposits because there are no adequate descriptions and keys of pollen grains of the species existing at the present day. As an aid to overcoming this defect the author describes the structure of the pollen grains of present-day representatives of the tertiary flora of the Green River shales, a middle Eocene formation. A key to the families of the present-day representatives of the Green River flora is first given, followed by separate descriptions of the pollen grain structure in the following families: Sparganiaceae, Pontederiaceae, Musaceae, Cannaceae, Cabombaceae (Nymphaeaceae in part), Myricaceae, Lauraceae, Crassulaceae, Simarubaceae, Malpighiaceae, Celastraceae, Sapindaceae, Anacardiaceae, Rhamnaceae, Vitaceae, Caprifoliaceae, and Cucurbitaceae.

C. R. M.

Morphology and Anatomy of the Fruit and Seed of certain Acanthaceae.—GUSTAV OEHM ("Beitrag zur Morphologie und Anatomie einiger Acanthaceen-Fruchte und -Samen," *Beihfte Bot. Centralbl.*, 1932, 49, 413-44, 31 figs.). The material studied was an undetermined species of *Calophanes* which was very similar to *C. Jasminum mexicanum* Nees, and also *C. (Linostylis) fasciculiflora* Fenzl. The young seed, while still enclosed within the fruit, is covered with a hyaline coating from which hairs are differentiated when moistened. The loculicidal capsule is borne on a short fruit stalk, through which there runs a strongly lignified and pitted parenchyma. The margin of the carpel produces a separating wall,

which is strongly thickened in the lower third. Between the two fibre bundles of the separating wall there is a thick-walled pitted parenchyma. A central vascular bundle extends throughout the length of the fruit, and also bears branches which are connected with the ovules. The epidermis of a dorsal suture to the fruit serves as an abscission tissue, and a zone of stone-cells at the apex of the swelling on the fruit as separating tissue (Abbruchsgewebe).

C. R. M.

Carpostegium in the Labiatae.—P. TIZIANO ("Contributo alla conoscenza del carpostegio nelle Labiate," *Nuov. Giorn. Bot. Ital.*, 1932, 39, 254–303, 4 pls.). The carpostegium is a structure, composed of hairs, situated in the mouth of the calyx in many of the Labiatae. Carpostegia may be classified in three groups according to whether they are composed of tufts, zones, or rings of hairs and these groups may be further subdivided according to the position of the carpostegium. Its formation is usually very precocious as it is quite evident in the bud long before flowering. A much later development was only recorded in certain species of *Teucrium* and *Thymus*. In structure the hairs of the carpostegium are always notably different from the external indumentum of the plant. The basal cell of each trichome is usually specialized in connection with the function of hygroscopic movement so that the carpostegium may be erect or connivent in varying states of humidity. This leads to the following classification: (1) Carpostegium connivent when dry, erect when humid. This gives protection to the nutlets during drought and permits of their dispersal during periods of humidity. (2) Carpostegium erect when dry, connivent when humid. This favours dispersal of the fruits during dry weather and protects them from premature germination during wet weather. (3) Carpostegium erect both when dry and humid. No hygroscopic function. (4) Carpostegium connivent both when dry and when humid. Here there may be occasionally a ballistic function, the seeds being expelled by a very strong impulse. Usually, however, the fruits are retained within the calyx which itself becomes detached from the plant. The following different rôles are suggested for the carpostegium: (1) Defence against rain. This is unimportant as, when necessary, the calyx becomes pendent. (2) Defence against insects. (3) Dispersion by ballistic mechanism. (4) Conservation of the fruits within the calyx until a favourable period. (5) Conservation of the fruits within the calyx during transport. The carpostegium here reaches its maximum development. (6) Defence of the corolla when in bud.

A. W. E.

Phyllotaxy of the Zingiberaceae.—A. WEISSE ("Zur Kenntnis der Blattstellungsverhältnisse bei den Zingiberaceen," *Festschrift Deutsch. Bot. Ges.*, 1932, issued as vol. 50A of *Ber. Deutsch. Bot. Ges.*, 327–63, 2 pls.). An account of the arrangement of the foliage and scale leaves, and of the veneration of the bud primordia in members of the Zingiberoideae and Costoideae. Details of the arrangement of the flowers in the inflorescences are also given. An important difference between the Costoideae and Zingiberoideae is in respect of the germination of the seed. In the Costoideae an ovoid cotyledon is produced, which bears at its apex a rudimentary absorbing organ. On the other hand, when the seed of the Zingiberoideae germinates, the greater part of the cotyledon remains imbedded in the seed as an absorbing organ, and only that part of it immediately beneath the plumule emerges.

C. R. M.

Criticisms on some Recent Work on Morphology in Angiosperms.—EDITH R. SAUNDERS ("On some Recent Contributions and Criticisms dealing with Morphology in Angiosperms," *New Phyt.*, 1932, 31, 174–218, 27 figs.). The paper

is a criticism of Dr. Arber's recent papers on vegetative and floral morphology together with some new evidence on the latter. Firstly, Miss Saunders deals with Dr. Arber's treatment of the "leaf-skin" theory. The argument that no boundary exists between "skin" and "core" in the stem is countered by the statement that lines of demarcation are seldom observable in any complex organism between different regions of the same continuous tissue. According to Dr. Arber, from observations of inflorescences of certain bamboos, the axis may terminate in a leaf. This is denied by Miss Saunders, who states that since a grass leaf has a circular exertion it cannot be said to be terminal on the axis that bears it. The remainder and bulk of the paper deals with floral morphology and the theory of carpel polymorphism. Dr. Arber's account of the relation of the median and lateral pairs of sepals in a few species with large lateral nectaries is said to give a one-sided picture. *Sisymbrium Alliaria* Scop. is cited in which four glands are present, the sepals being approximately equal and occupying the same level. The single tetramerous whorl is fundamental, "deformation" resulting from an isobilateral disposition of the nectaries. The fundamental ground plan in the Cruciferae is represented by $K4C4A4+4G4$. The mode of origin of the venation system in the Crucifer calyx as also the vascular anatomy of the gynoecium in the Fumarioideae, is misinterpreted by Dr. Arber, who describes the appearances observed in a reverse order to the evolutionary development. Dr. Arber's suggestion regarding the androecium in the Fumarioideae is entirely against the evidence. The rational ground plan here is $K2C2+2A2+2$ (split) $G4$ (of two pairs). The view that the syncarpous gynoecium should not be regarded as composed of carpels is illogical. That the commissural position of the Crucifer stigma results from "promotion" of the ovule-bearing marginal veins to a "new status" is denied and the case of *Eschscholtzia* quoted in which styles and stigmas may range from two to twenty. It is claimed that no single fact brought forward is at variance with or controverts the "leaf-skin" theory or that of carpel polymorphism. New evidence tendered by Miss Saunders deals with the origin of the sepal marginal veins in various dichlamydeous families and of the perianth marginal veins in some monochlamydeous types. Also the relation between the bracts and the orientation of the outermost floral whorl in certain tetramerous types, and of the widespread occurrence of the formation of midribs of the floral whorls from trunk cords which later become dissociated into their components.

F. B.

Proliferations of the Floral Axis in Hibiscus.—H. F. BERGMAN ("Intracarpellary Fruits and other Central Proliferations of the Floral Axis in *Hibiscus*," *Amer. J. Bot.*, 1932, 19, 600-603, 2 figs.). Intracarpellary proliferations were observed as the result of hybridization experiments in certain forms of *Hibiscus*. The young seed-pods dropped in a few days and several were found to contain small complete pistils. Pollination was found to be unnecessary for their production though the size of the included pistil depended indirectly upon pollination. They were always proliferations of the central axis of the capsule. The included pistil in unpollinated flowers varied from 3 to 5 mm. in length and were normal, with short styles and no stigmas. In pollinated flowers they ranged from 8 to 10 mm. long and possessed well-developed styles and stigmas. These proliferations resembled those described by Harris in *H. esculentus*. Another type was found in a *Hibiscus* of unknown parentage in which a secondary flower was developed within the ovary of the primary flower. After the petals of the primary flower had fallen the secondary flower broke through and emerged as a small double flower. These types of proliferations are always found on plants resulting from

crosses of definite parents, and their cause seems to be a disturbance brought about by hybridization. F. B.

Floral Morphology of the Hypecoideæ.—AGNES ARBER ("Studies in Floral Morphology. IV. On the Hypecoideæ, with special reference to the Andræcium," *New Phyt.*, 1932, 31, 145-73, 12 figs.). This paper continues the study of the Fumariaceæ with the sub-family Hypecoideæ, containing the genera *Hypecoum*, *Chiazospermum*, and *Pteridophyllum*. The vascular structure of three species of *Hypecoum*: *H. leptocarpum* Hk. f. & Thoms., *H. procumbens* L., *H. pendulum* L. and *Chiazospermum erectum* Bernh. is described in great detail, while *Pteridophyllum racemosum* Sieb. & Zucc. is briefly summarized at the end of the paper. It is concluded that the structure of the inner petals of *Hypecoum* lends no support to Eichler's view that these petals are each equivalent to a staminal phalange of the Fumarioideæ. In *Hypecoum* the filaments develop glandular tissue near the base, mainly confined to the margins. These glands are supplied by delicate phloem strands which, though not easy to trace, may be derived from the phloem of the stamen bundle or from a phloem nexus in the receptacle. The inner stamens of *Hypecoum* may be one- or two-bundled even in the same inflorescence. The two-bundled character, which may be masked by subsequent fusion, is due to a special type of bundle branching associated with the superposition of stamen to petal. The relative width of the filament base appears to decide whether the bundle pairs retain their independence or fuse. In *Pteridophyllum* the stamens seem all to be one-bundled and alternate with the midribs of the petals, instead of being opposite to them as in the other members of the sub-family. These facts support the view that the two-bundled character of *Hypecoum* is an outcome of the superposition of stamens to petals. F. B.

CRYPTOGAMIA.

Pteridophyta.

Fossil Gleicheniaceous Fern.—T. G. TUTIN ("A Cretaceous Gleicheniaceous Fern from Western Greenland," *Ann. Bot.*, 1932, 46, 503-08, 1 pl. and 2 figs.). A new genus, *Gleicheniopsis*, is proposed for certain species formerly included in *Gleichenites*, but differing markedly from *Gleichenia* in having numerous small sporangia in the sorus and a very low number of spores. *Gleicheniopsis fecunda* is the type of the genus. *G. Sewardii* is separated as a new species; and a third species is indicated, but is left unnamed. When fertile these are readily distinguishable, but not so when sterile. The material came from Ritenbenk's coal-mine on Disko Island, and from Patoot on the mainland opposite in Greenland. The method of extracting the sporangia and the spores from the mineral matrix is described. A. G.

Osmunda.—LUDWIG ROSSI ("Über *Osmunda regalis* L. in Süd-Kroatien," *Magyar Bot. Lapok.*, 1932, 31, 33-36). Description of some new localities in South Croatia for *Osmunda regalis*, which assumes three forms, according as it occurs on drier ground, in swamps, or in shade. A table of measurements is given, and various forms are defined with reference to the shape of the segments. The periodical increase and decrease of the plants is discussed; the tendency is for them to disappear. A. G.

Osmunda Sori.—N. P. CHOWDHURY ("On the Occurrence of Superficial Abaxially Placed Sori in *Osmunda Claytoniana*," *J. Indian Bot. Soc.*, 1932, 11, 137-45, 1 pl., 3 figs.). The following abnormal features were found in several

specimens of *Osmunda Claytoniana* from Kashmir. Superficial sporangia occurred frequently at the transition between fertile and sterile regions of the frond. These sporangia were arranged in definite sori on the under-surface of pinnules which otherwise resemble the normal sterile pinnules; this may possibly be of the nature of a reversion. The evidence available suggests that the primitive condition of the Osmundaceæ was the superficial (abaxial) sorus.

A. G.

P. N. MEHRA ("A Note on the Occurrence of Superficial Sori in *Osmunda Claytoniana*," *J. Indian Bot. Soc.*, 1932, 11, 146-7). Some further evidence in support of Chowdhury's conclusion, published in the same number of the *Journal*, that the abaxial soral condition may have been the ancestral feature in the Osmundaceæ.

A. G.

Neochheiropteris.—R. C. CHING ("Neochheiropteris Waltoni Ching," *Hooker's Icones Plantarum*, 1932, II, Pt. 3, Tab. 3158). Description and figures of *Neochheiropteris Waltoni*, a new species from near Lhasa, Tibet, which constitutes a second species for the genus, the type of which, *N. palmatopedata*, was discovered in Yunnan, and more lately was gathered in West Szechwan and Kweichow.

A. G.

Fern Studies.—WILHELM TROLL ("Botanische Mitteilungen aus den Tropen (IV-VII). Ergebnisse der Sunda-Expedition der Notgemeinschaft der Deutschen Wissenschaft, 1929-30," *Flora*, 1932, N.F. 26, 371-417, 29 figs.). The subjects of the four chapters are as follows: IV. Gemmiferous prothallia in *Antrophyum callafolium*. V. Rudimentary pinnæ on the frond-base and stem-internodes of *Stenochlaena palustris*. VI. Leaf-formation in *S. sorbifolia* and *S. aculeata*. VII. Heterophylly of *Lindsaya repens*.

A. G.

Equisetum.—A. K. MITRA ("On a Branched Cone of *Equisetum maximum*," *J. Indian Bot. Soc.*, 1932, 11, 119-26, 1 pl. and 2 figs.). Description of an abnormally branched cone of an *Equisetum*, probably the result of an injury, with a detailed account of the vascular strands in the pith of the main cone-axis.

A. G.

Lycopodium porophyllum.—L. R. WILSON ("The Identity of *Lycopodium porophyllum*," *Rhodora*, 1932, 34, 169-72). The uncertainty about *Lycopodium porophyllum* Lloyd & Underwood is solved. The type specimen is identical with *L. Selago* var. *patens*. The material in the Gray Herbarium proves to be *L. lucidulum* var. *occidentale*, a new combination. The spores are a good distinctive character; those of *L. Selago* are larger and more regularly papillate than those of *L. lucidulum*. *L. Selago* has a var. *appressum* with leaves crowded and much appressed; and a var. *patens* with leaves spreading and often reflexed. *L. lucidulum* has leaves serrate; but its var. *occidentale* has leaves entire or slightly serrate.

A. G.

Selaginella in China.—O. C. SCHMIDT ("Plantæ Sinenses a Dre H. Smith annis 1921-22 lectæ. XXIII. Selaginellaceæ," *Acta Horti Gothenburgensis*, 1929, V, 51-4). A list of fourteen species of *Selaginella* collected in the provinces of Chili, Szechwan, and Yunnan, including one new species, *S. Smithii*, named after the collector.

A. G.

Nathorstiana.—KARL MÄGDEFRAU ("Über *Nathorstiana*, eine Isoëtacee aus der Neokom von Quedlinburg a. Harz," *Beih. Bot. Centrbl.*, 1932, 49, Abt. 2, 706-18, 2 pls. and 2 figs.). A re-examination of the material from which P. B. Richter described the fossil plant, *Nathorstiana*. The original description is

amended, and some new observations are added, the most important of which concerns the development of the stem-base. This latter was conical at first, then more or less cylindric, then bilobed, and, finally, four-lobed. The genus can with some certainty be referred to Isoëtaceæ, and occupies an intermediate position in the phylogenetic series from *Pleuromeia* to *Isoëtes*. The plant grew on maritime dunes.

A. G.

Bryophyta.

Notothylas.—S. K. PANDE ("On the Morphology of *Notothylas indica* Kashyap," *J. Indian Bot. Soc.*, 1932, 11, 169–80, 5 pls.). An account of *Notothylas indica*, its structure, sex organs, and the development of its embryo. It is chiefly found on the plains, but sometimes on the hills of North-West India. It is monocious and protandrous. The development of the sex organs is of normal type; the number of neck-canal-cells is usually four, sometimes six; two anomalous archegonia were observed. The first division of the oospore is transverse; the capsule and seta arise from the uppermost tier, the foot from the lower two tiers. The columella arises from the endothecium, and the archesporium from the inner layer of the amphithecium. The sporogonium normally is two-valved; the valves are hygroscopic, and the sporogonium dehiscence along one suture, as a rule. The marginal cells of the valves are very thick and brown.

A. G.

Cyathodium.—L. P. KHANNA ("Germination of Spores of *Cyathodium Kashyapii* Khanna," *Annales Bryologici*, 1932, 5, 99–102, 4 figs.). In germination, the spores of *Cyathodium Kashyapii*, though they may rupture at one, two, three, or four places, yet in 45 p.c. of the cases rupture at two points, from one of which the germ tube emerges and from the other the rhizoid. In this they agree with the germinating spores of *Targionia*.

A. G.

Tesselina.—J. SUZA ("Über das Vorkommen von *Tesselina pyramidata* Dum., eines mediterranen Lebermooses, in Mähren, Č.S.R.," *Engler's Bot. Jahrb.*, 1932, 65, 60–74, 2 maps). A full account of the distribution of *Tesselina pyramidata* with maps showing its distribution in Europe, Asia Minor, and North Africa; it also occurs in the Canary Islands and Brazil. From this distribution it might possibly be regarded as a tropical or subtropical xerophyte with some outliers in Middle Europe. But after a detailed examination of the plant associations among which *Tesselina* occurs in the Moravian valleys, Jihlava-tal and Dyje-tal, the author concludes that *Tesselina pyramidata*, *Notholana Marantia*, and *Diplachne serotina*—three Mediterranean xerothermophytic elements—are, so far as concerns their stations in Moravia and Austria, survivals of a Tertiary flora.

A. G.

Polarity in Marchantia.—HUGH DICKSON ("Polarity and the Production of Adventitious Growing Points in *Marchantia polymorpha*," *Ann. Bot.*, 1932, 46, 683–701, 1 pl. and 31 figs.). An investigation of the effect of X-rays on gemmæ of *Marchantia polymorpha* led to an examination of polarity and dominance in the gemmæ. When the gemmæ were cut in various ways, it was found that the younger cells always dominate the older in the production of buds; but this is reversed if the younger cells are shielded from the light. Gemmæ were also caused to produce adventitious buds as a result of treatment by ultra-violet light, X-rays, drying, and plasmolysing solutions. The relation between bud-production and increasing doses of X-rays was studied on nearly 4000 gemmæ. Hypotheses are suggested for explaining the effect of X-rays.

A. G.

Sewardiella tuberifera.—G. CHALAUD ("Mycorrhizes et Tuberisation chez *Sewardiella tuberifera* Kashyap," *Annales Bryologici*, 1932, 5, 1-16, 1 pl.). An account of the Indian hepatic, *Sewardiella tuberifera*, and of its reaction to the invasions of a mycorrhiza. The hepatic forms a tuber or bulb at the end of its axis each year. This bulb develops into the gametophyte in the following year and forms a new bulb. The bulb serves to bridge over the dry season; it is proof against invasion by the fungus until it has become converted into the new gametophyte. The fungus penetrates into the older tissues; it is of the mycorrhizal type found in *Fegatella*, *Fossombronina*, etc. A. G.

Plagiochila.—HELMUT CARL ("Die Arttypen und die systematische Gliederung der Gattung *Plagiochila* Dum.," *Annales Bryologici*, 1931, Supplementary Vol. II, 1-170, 13 pls.). A revised treatment of the genus *Plagiochila*. The author discusses the different methods followed by Lindenberg, Spruce, Schiffner, Stephani, Dugas, in arranging the innumerable species; and states his own views, which approach those of Schiffner as to subgenera, and those of Spruce as to specific characters. In another chapter he reviews the value of the vegetative and reproductive organs as taxonomic characters. He then proceeds to divide *Plagiochila* into three subgenera according to the shape and position of the leaves—*Cucullifoliae* (with 1 sp.), *Oppositae* (9 spp.), and *Eu-Plagiochilae* containing the rest of the genus, subdivided geographically into neotropic, palæotropic, and austral-antarctic groups. Each of these subdivisions is preceded by a key guiding the student to the numerous sections, under which the species are arranged. Upwards of 400 species are classified. Finally, the phylogeny of the genus and the distribution and affinities of the groups of species are discussed; and some general remarks on the systematy of Hepaticae are added. A. G.

Scapania Degenii.—V. SCHIFFNER ("Über *Scapania Degenii* Schiffn.," *Annales Bryologici*, 1932, 5, 115-20, 1 pl.). Description and figures of *Scapania Degenii* collected in Oetztal in Tirol by Dr. A. von Degen in 1910, with an account of a visit to the original locality in search of more material for distribution, and with critical remarks. A. G.

Ocelli in Hepatics.—WERNER ZWICKEL ("Studien über die Ocellen der Lebermoose," *Beih. Bot. Centralb.*, 1932, 49, 569-648, 8 figs.). A discussion of the nature of the ocelli in hepatics, of their cytology and histology, and of their mode of occurrence. They differ in the structure of their cell-wall from the ordinary leaf-cells in being destitute of the ordinary thickening of wall and angles. The contents consist of an oil named Ocellitin by the author; nucleus and plasma are present, but are thrust aside. The ocelli exhibit types of structure peculiar to certain genera of *Lejeuneae*, and types of arrangement which correspond with other systematic groups. The ocelli can occur on other than the ordinary foliage leaves. The phylogenetic origin of the ocelli is unknown; nor is their physiological significance understood. They occur only in the *Jubuleae*, but not in all the genera. Of the 234 ocellate species examined by the author twelve belong to *Holostipae* and 222 to the *Schizostipae*. The ocelli are of great value to the systematist for the discrimination of genera and species. A. G.

Ocelli in Hepatics.—WERNER ZWICKEL ("Verbreitung der Ocellen bei den Lebermoosen," *Annales Bryologici*, 1932, 5, 145-58). A series of seven tables in which 234 species of *Lejeuneae* are grouped in accordance with the nature of the ocelli in their leaves—that is, whether the ocelli be scattered, seriate, moniliate, suprabasal, basal, geminate, or aggregate. The frequency, the size of the ocelli, and other details are shown in the tables. A. G.

Hepaticæ selectæ.—FR. VERDOORN ("Hepaticæ Selectæ et Criticæ, Series III et IV (1932)," *Annales Bryologici*, 1932, 5, 125-44, 5 figs.). A list of 100 species of hepatics from various parts of the world, with critical notes, descriptions of novelties, and some photographs of bryophyte vegetation in the Malay Islands and India. A. G.

Taxonomic Hepaticology.—FR. VERDOORN ("The Future of Taxonomic Hepaticology," *Annales Bryologici*, 1932, 5, 121-4). A strong appeal for a more intensive study of the hepatics of the world, and especially for a thorough revision and sound classification of the species of the larger genera. At present the taxonomy of the hepatics is chaotic; experts are few; and the task of determining new and large collections is shirked, owing to the difficulty of understanding written descriptions and of obtaining authentic material for comparison; the type specimens are often of poor quality and scanty in amount. The plan of Stephani's "Species Hepaticarum" with its geographical grouping of species, and its failure to emphasize specific characters, is out of touch with the older "Synopsis Hepaticarum" of Gottsche, Lindenberg, and Nees. What is needed is a system of monographs of the genera, and a close study of the variability of the species, and plenty of workers at the group. A. G.

Dillenian Relic.—ORESTE MATTIROLO ("Un importante cimelio briologico donato al Museo del R. Orto Botanico della Università di Torino," *Nuov. Giorn. Bot. Ital.*, 1932, 39, 223-5). The museum of the botanic gardens at Turin has recently acquired a *hortus siccus* which was prepared and annotated by Dillenius and given by him to Prof. Giovanni Pietro Maria Dana, who came on a visit to England in 1740, just when Dillenius was about to print his "Historia Muscorum," as is stated in a manuscript note. The subsequent history of the volume has been traced. It contains fifty-four mosses, thirty-three lichens, seven hepatics, and three algae. Sir James Edward Smith dedicated the fern genus *Danaea* to Dana. A. G.

Moorland Mosses.—W. WATSON ("The Bryophytes and Lichens of Moorland," *J. Ecol.*, 1932, 20, 284-313, 3 figs.). A tabulated list is given of the bryophytes and lichens of sixteen moorlands, which comprise five dry upland heaths, seven heather moors of damper nature, and four wet heaths. These moorlands, from various parts of the country, are described and compared; and details of the constituent plants are noted. The influence of a smoky atmosphere is considered, and some modifications of bryophytes in accordance with habitat are discussed. A. G.

Splachnaceæ.—H. GAMS ("Die Verbreitung einiger Splachnaceen und der *Oreas Martiana* in den Alpen," *Annales Bryologici*, 1932, 5, 51-68, 6 figs.). The author discusses the distribution of *Tayloria Rudolphiana*, *T. Hornschuchii*, and *Voitia nivalis*, as also that of *Oreas Martiana*, in the Alps, and gives lists of the plants associated with them. A. G.

Bulgarian Mosses.—J. SZEPESFALVI ("Ein Kleiner Beitrag zur Moosflora von Bulgarien," *Magyar Bot. Lapok.*, 1932, 31, 47-51). A list of eleven hepatics and fifty-four mosses collected on the Rhodope and Balkan mountains by A. Pézses in 1929. A. G.

African Mosses.—J. SZEPESFALVI ("Additions à la Flore bryologique de l'Afrique septentrionale. Mousses recueillies par Mr. le Baron Dr. G. de Andréan-

szky," *Magyar Bot. Lapok.*, 1932, 31, 143-6). A list of seven hepatics and twenty-five mosses collected during one of a series of phytogeographical journeys in North-West Africa, chiefly in Morocco and the Atlas Mountains. A. G.

Sumatra Mosses.—H. N. DIXON ("Contributions to the Moss Flora of Sumatra," *Annales Bryologici*, 1932, 5, 17-50). A list of 172 mosses from Sumatra mostly collected in recent years by various travellers. Among them are seventy-three species recorded for the first time, in addition to twenty new species which are described; and there is a new genus, *Tristichella*, of the family Sematophyllaceæ. A. G.

East Indian Bryophytes.—TH. HERZOG ("Neue und bemerkenswerte Bryophyten, von H. Burgeff 1927-28 auf Java und den Philippinen gesammelt," *Annales Bryologici*, 1932, 5, 69-82, 3 figs.). A list of thirteen mosses and twenty-six hepatics collected by H. Burgeff in Java and the Philippines. The novelties are one moss, eight hepatics, and some varieties. A. G.

Malayan Hepatics.—TH. HERZOG ("Neue Hepaticæ aus der weiteren Indomalaya," *Annales Bryologici*, 1932, 5, 83-98, 8 figs.). Descriptions of eleven new species of hepaticæ collected in Sumatra, Borneo, and New Guinea by Goebel, Balneti, and Wegner respectively. A. G.

Bryum in New Zealand.—G. O. K. SAINSBURY ("Some New Zealand Species of *Bryum*," *Annales Bryologici*, 1932, 5, 111-14). The author dwells on the difficulty of treating systematically the New Zealand species of the *Rosulata* section of *Bryum*. H. N. Dixon has recently reduced them to three species—*B. truncorum*, *B. Billardieri*, *B. campylotheicum*. Sainsbury sets out their distinguishing characters as given in Hooker's "Handbook," Dixon's "Studies in the Bryology of New Zealand," and Brotherus in "Pflanzenfamilien"; and then discusses the difficulties he has encountered in dealing with large amounts of material from different localities owing to variability in the characters displayed by the plants. He thinks that he can for the most part recognize *B. campylotheicum*; but he finds it difficult to settle on characters which clearly and definitely separate *B. Billardieri* from *B. truncorum*. A. G.

Central American Mosses.—EDWIN B. BARTRAM ("Mosses of Northern Guatemala and British Honduras," *J. Washington Acad. Sci.*, 1932, 22, 476-82, 1 fig.). A list of forty-four mosses collected by H. H. Bartlett in the spring of 1931 in the El Cayo region of Western British Honduras and in the Petén district of Guatemala. It is the first list of mosses from the Maya area of Central America; the species have an affinity with those of Vera Cruz and Yucatan, as well as, to a less extent, with those of the Antilles and Northern South America. A new species of *Campylopus* is described. A. G.

Iowa Bryophyta.—H. S. CONARD and B. O. WOLDEN ("A Key to the Mosses of the Okoboji Region," *Univ. Iowa Studies Nat. Hist.*, 1932, 14, no. 7, 1-24, 2 pls.). The area investigated is north-western Iowa. There is a key provided to cover all the genera of hepatics and mosses, and further keys to the species are to be found where necessary under the genera. Both leaf and capsule characters are employed, to facilitate the naming of sterile as well as fertile specimens; and further assistance is given in the fifty-two figures and the glossary. A. G.

Thallophyta.

Algæ.

Gases in Algæ.—SILVIA COLLA ("Ricerche sul contenuto gassoso di alcune alghe," *Annali di Botanica*, 1932, 19, 426-64, 4 figs.). The receptacles of *Fucus virgoides* contain a mixture of gases which vary in volume and pressure in the course of the day. The mixture contains oxygen, carbonic acid and nitrogen, but no carbon monoxide nor reducing gas. The maximum production of gas is during the hours of brightest light and occurs exclusively in the receptacles, being secreted by the hyphæ of the central tissue, and forming bubbles in the gelatinous matter between the hyphæ. The gas which varies most in percentage during the day is the oxygen, and the percentage is greatest in the younger receptacles. It rises and falls with the intensity of the light and the degree of photosynthesis. The pressure also rises and falls with the percentage of oxygen. The carbonic acid gas shows two percentage variations, one nocturnal, the other during the heat of the day; the first is a relative maximum due to diminution of the oxygen, the other is absolute maximum due to respiratory exchange rising with the temperature.

A. G.

Gases in Algæ.—ZIPORÀ DANIN ("Sulle cavità gassose di *Rivularia polyotis* (J. Ag.) Hauck e sui Gas in essa contenuti," *Nuov. Giorn. Bot. Ital.*, 1932, 39, 165-181, 4 figs.). As in some other marine algæ, cavities filled with gas are found also in colonies of *Rivularia polyotis*, a saxicolous species found between tide-marks. The gas is a mixture of oxygen, carbonic acid, and nitrogen; the first two of these undergo daily variation. The percentage of oxygen varies with the degree of illumination. The carbonic acid shows two percentage maxima, one at night when the oxygen falls to a minimum, and the other at the hottest time in the day, being attributed to respiration. In colonies placed at a depth greater than normal, the percentage of oxygen decreases and that of carbonic acid increases. The production of gas distends the cavity to four times its volume, and alters the disposition of the algal filaments and their sheaths.

A. G.

Peridinium.—M. LEFÈVRE ("Monographie des especes d'eau douce du genre *Peridinium*," *Archives de Botanique*, Caen, 1932, 2, Mém. No. 5, 1-210, 6 pls., 915 figs.). A monograph of the freshwater species of *Peridinium*, divided into two parts, the first treating of the generic characters, reproduction and the evolutionary cycle, habit and distribution, methods of cultivation, parasites, general variations in the genus, affinities, the idea of the species; the second part is concerned with systematic investigation. Two subgenera are maintained, *Cleistoperidinium* with four groups, and *Poroperidinium* with eleven groups. A bibliography and index complete the monograph.

A. G.

Lake Plankton.—W. H. PEARSALL ("Phytoplankton in the English Lakes. II. The Composition of the Phytoplankton in Relation to Dissolved Substances," *J. Ecol.*, 1932, 20, 241-62, 1 fig.). A study of the periodicity of the more important plankton algæ compared with the results of water analysis. It appears that diatoms occur when the waters are richest in nitrate, phosphate, and silica (in winter and spring). Green algæ and desmids occur in summer, when nitrates and phosphates are low; desmids occur particularly when calcium and the nitrate/phosphate ratio is low. *Dinobryon* prefers a rather higher ratio of nitrate to phosphate. Myxophyceæ are correlated with high organic matter, and thrive in minimal quantities of nitrate and phosphate.

A. G.

Perone dimorpha.—A. PASCHER ("Über eine in ihre Jugend rhizopodial und animalisch lebende epiphytische Alge (*Perone*)," *Beih. Bot. Centralb.*, 1932, 49, Abt. 1, 675–85, 7 figs.). An account of *Perone*, a new genus of protococcoid Heterokontæ, found growing epiphytically on *Sphagnum* in the Musikantenteichen near Hirschberg. Its protoplast is honeycombed with large vacuoles. In reproduction the cell divides into several amoeboid germs, which, after a while coming to rest, nearly always live for a time in a naked sessile amoeboid form, feed as animals, grow in size and increase their chromatophores; eventually they revert to the cell-walled epiphytic state. A. G.

Nucleolus in Desmidiaceæ.—OSKAR KOPETZKY-RECHTERPERG ("Die Nucleolen im Kern der Desmidiaceen," *Beih. Bot. Centralb.*, 1932, 49, Abt. 1, 686–701, 1 pl.). The nucleolar substance in the nucleus of the Desmidiaceæ occurs either as a solitary nucleolus or in the form of several scattered nucleolar masses. Usually it is the relatively larger species of several genera that have the latter type. Transitions are found in the genus *Closterium*. In every case a given species always exhibits the same type of nucleoli—they are fixed by heredity and can be used as specific characters. In the Desmidiaceæ the nucleoli are not concerned in the formation of the chromosomes, nor is it probable that they supply dissolved matters to the chromosomes. A. G.

Contractile Vacuoles in Diatoms.—A. PASCHER ("Über das Vorkommen von Kontraktilen Vakuolen bei pennaten Diatomeen," *Beih. Bot. Centralb.*, 1932, 49, Abt. 1, 703–09, 6 figs.). In a species of *Nitzschia* akin to *N. Hantzschiana* fission of the protoplast into two and four elongate sub-protoplasts was observed; these divisions had for a while a pair of normal contractile vacuoles which pulsed alternately. These vacuoles were mostly situated towards one end of the sub-protoplast; after a time they disappeared. It was not possible to determine whether the protoplasts were vegetative reproductive bodies or gametes. A. G.

Gomphonema.—ANTON MAYER ("Die bayerischen Gomphonemen," *Denkschr. Bayer. Bot. Ges. Regensburg*, 1928, 17, 83–128, 5 pls.). An account of the diatom genus *Gomphonema* as it occurs in Bavaria, with descriptions of the genus, its species, varieties and forms, together with a key, citation of literature, localities, critical notes, and 130 figures. A. G.

Danish Algæ.—JOHS. BOYE PETERSEN ("The Algal Vegetation of Hammar Bakker," *Bot. Tidsskrift*, 1932, 42, 1–48, 21 figs.). An account of the algal vegetation of Hammar Bakker, sandy hills without springs save those of Vældmose; the algæ are of aerial character and occur in or on the ground and on trees and shrubs. Notes are given on the algæ collected from various plants; samples of nearly a score of different soils were cultivated in nutrient solutions, and the algæ therefrom were determined. Also the algæ of the scanty springs of Vældmose were examined. A systematic list of 105 species follows, comprising Cyanophyceæ, Diatomaceæ, and Chlorophyceæ—105 species in all, with several varieties. A. G.

Salt Marsh Algæ.—NELLIE CARTER ("A Comparative Study of the Alga Flora of Two Salt Marshes. Part I," *J. Ecol.*, 1932, 20, 341–70, 2 figs.). This investigation was started at the suggestion of the late Prof. Yapp, who wished a record of the alga flora of the Dovey estuary to be made. A salt marsh area on Canvey Island in Essex has also been kept under observation for three years. The topography of the two marshes is described, as are also the phanerogam vegetation with its zonation, and the zones with their algal inhabitants. Then the

pans and channels, the escarpments, and pioneer algæ are considered. Some observations on tidal effects are recorded. A. G.

Life-history of *Ulothrix*.—EDNA M. LIND ("A Contribution to the Life-history and Cytology of Two Species of *Ulothrix*," *Ann. Bot.*, 1932, **46**, 711–24, 2 pls. and 12 figs.). Two species of *Ulothrix*, found growing together by a water trough in Derbyshire, are described, the one as *U. zonata*, the other as *U. rorida*. The reaction of *U. zonata* to unfavourable conditions of environment is described, as well as a form of vegetative reproduction by fragmentation of its filaments; an account is also given of the structure, occurrence, and germination of the microspores. *U. rorida* is found growing unmixed on a stone weir in Graves Park, Sheffield. Its structure and life-history, and the cytology of its reproductive cells, are described. All the filaments, the zoospores and gametes are haploid, the zygote being the only diploid phase in the life-cycle. The duration of the resting stage of the zygote could not be ascertained. A. G.

Mitosis in *Draparnaldia*.—JUDITH M. FERGUSON ("On the Mitotic Division of *Draparnaldia glomerata*," *Ann. Bot.*, 1932, **46**, 703–09, 1 pl.). Mitotic division in *Draparnaldia glomerata* is described and the chromosome number is found to be 8. Spireme and spindle were not observed; the chromosomes are very small and result from the coalescence of still smaller granules. A relationship between the staining reactions of pyrenoid and nucleus is noted. The escape of quadriciliate spores of different sizes has often been seen, but without evidence that the smaller spores behave as gametes. No fusions have been observed, and the branch cells have produced but one spore each. The bearing of these results upon the possible life-cycle of the algæ is discussed. A. G.

Phæocystis.—R. E. SAVAGE ("Phæocystis and Herring Shoals," *J. Ecol.*, 1932, **20**, 326–40, 1 pl. and 11 figs.). The adverse influence of *Phæocystis* on the migration of herrings has already been treated by the author ("Ministry of Agric. Fish. Invest.," 1930, Ser. II, 12, no. 2). In the spring there is a great development of plankton in the sea causing the water to become discoloured and of a pungent odour. In the southern North Sea this is principally due to *Phæocystis*. But discoloration is also caused by *Chatoceros* in spring, and *Rhizosolenia* and *Biddulphia* in autumn. *Phæocystis Pouchetii* (Hariot) Lagerheim is a minute Cryptomonad flagellate which forms gelatinous colonies of brownish-yellow colour. There is some evidence that herrings are repelled by *Phæocystis* plankton, and are diverted from their normal migration track. There is no evidence that concentrations of diatom plankton act as barriers to the passage of herrings. A. G.

Phæosporeæ.—CAMILLE SAUVAGEAU ("Sur quelques algues phéosporées de la rade de Villefranche, Alpes Maritimes," *Bull. Station Biologique d'Arcachon*, 1931, **28**, 1–168, 32 figs.). An account of the investigations of the life-history of various Phæosporeæ made by the author during five visits to the Russian zoological station at Villefranche. These researches include *Aglaozonia chilosa* and *Cutleria monoica* and the culture of zoospores and oospores respectively; *Halopteris filicina* and the culture of the zoospores of the plurilocular sporangia; *Myriotrichia repens* and *M. adriatica* and the culture of their zoospores; other species of *Myriotrichia*; *Protasperococcus*, a new genus, and the culture of the zoospores of its unilocular sporangia; *Zosterocarpus Edogonium*; *Arthrocladia villosa* and its life-history; *Sporochnus pedunculatus* and the culture of its zoospores; the *Spermatochneæ* comprising *Spermatochneus paradoxus*, *Nemacystus ramulosus*, and *Stilophora adriatica*, and the culture of their zoospores; and a few other algæ. A. G.

Plethysmothallus.—CAMILLE SAUVAGEAU ("Le Pléthysmothalle," *Bull. Station Biologique d'Arcachon*, 1932, 29, 1-16). A résumé of the outcome of the researches made by the author on the life-history of several of the Phæosporeæ. The word "pléthysmothalle," first coined by him in 1927, is used to indicate that inconspicuous (adélophycé) or microscopic phase of the alga, when it is multiplying itself by the production of sporangia. In due course, at the proper season the alga swings over to its other phase—the conspicuous (délophycé) alga as we know it, the alga as described in our floras. After a few months or weeks this alga sheds its zoospores and dies. The zoospores give rise once more to the inconspicuous phase, which is also named éclipsiophycé, the eclipsed or hidden phase. In the pléthysmothalle active multiplication goes on, but our knowledge of the hidden history of many of the algæ is far from complete. A. G.

Macrocystis.—WILLIAM ALBERT SETCHELL ("Macrocystis and its Holdfasts," *Univ. Calif. Pub. Bot.*, 1932, 16, 445-92, 16 pls.). A discussion of the distribution of *Macrocystis* and of the question whether the genus comprises one species or more. Particular attention is given to the basal growth, the holdfast and the axial branching, and to the status of the two apparently distinct species of the Pacific coast of North America. In these the arrangement of the hapteres is different. In *M. pyrifera* they are multifarious on the cylindrical segments of the stipe, while in *M. integrifolia* they are bifarious on the margins of the flattened segments. A. G.

Xiphophora.—E. M. HEINE ("The New Zealand Species of *Xiphophora* with some Account of the Development of the Oogonium," *Ann. Bot.*, 1932, 46, 557-69, 2 pls. and 28 figs.). An account of the two species of *Xiphophora*. *X. gladiata* is Australian and Tasmanian; and *X. chondrophylla* occurs in New Zealand—var. *minor* on the northern coast of the North Island, var. *maxima* on all coasts as well as on Auckland, Campbell and Chatham Islands. The distinguishing characters of the two species and the varieties are discussed. A description is given of the internal structure, the dividing cell, and the development of the conceptacle, also the development of the oogonium. A. G.

Chinese Algæ.—VIOLET M. GRUBB ("Marine Algæ of Korea and China, with Notes on the Distribution of Chinese Marine Algæ," *J. Bot.*, 1932, 70, 213-9, 245-251, 1 map). A list of five marine algæ from Korea, and twenty-nine from Pei-tai-ho, China, collected by Miss Galbraith and the author respectively. Of the ninety-eight species now known from China twelve are added in the present paper. A map is given, in which are shown the chief ocean currents off the east coast of China and the stations where algæ have been collected. A table is given in which the distribution of the algal flora of China north and south of the Yangtze River is compared with that of the Korean coasts (east, south-east, and west). Of ninety-eight Chinese algæ, thirty-one are found also in Korea, but mostly on the west coast only. The respective ocean currents that affect the coasts of Japan, China, and Korea are discussed, and shown in a map; and their influence on the different classes of algæ is explained, for instance, the absence of *Fucus* and the larger Laminariaceæ from the Chinese coast. A. G.

Burmese Characeæ.—B. P. PAL ("Burmese Charophyta," *J. Linn. Soc. Bot.*, 1932, 49, 47-92, 11 pls. and 6 figs.). An account of the Characeæ of Burma, comprising fourteen species of *Nitella*, one of *Nitelopsis*, and fourteen of *Chara*. The novelties described are six species of *Nitella* and four of *Chara*; they are all figured, as also is the rare *C. Wallichii*. The morphology of all the species is

described, and their affinities are discussed. Methods of preservation and staining of the material are given. Information as to the distribution and season of the species is supplied, as also about the climate of the chief centres of collection, and the ecological factors are discussed.

A. G.

Fungi.

Pythium Debaryanum in America.—J. J. TAUBENHAUS and WALTER N. EZEKIEL ("On a new Damping-off Disease of Texas Blue-Bonnets," *Mycologia*, 1932, 24, 457-9, 1 text-fig.). The Texas blue-bonnet (*Lupinus texensis* Hook.) is a native annual plant and the official State flower of Texas. The authors found that a group of these plants, after transference to the greenhouses of the Texas Agricultural College, began to wilt and die off. An abundance of *Rhizoctonia* and *Pythium* mycelia had invaded the tissues. These fungi were cultured and finally determined as *Rhizoctonia* sp. and *Pythium Debaryanum*. They were found to be soil-borne and were readily controlled by steam sterilization of the infested soil; disinfection of the young seedlings by dipping them in bichloride of mercury was also effective.

A. L. S.

Blight due to Phytophthora.—GEORGE F. WEBER ("Blight of Peppers in Florida caused by *Phytophthora Capsici*," *Phytopathology*, 1932, 22, 775-80, 4 text-figs.). This blight of peppers in Florida had already been described as similar to a blight of Chile peppers in New Mexico. Weber has described the attack of the fungus on stems, branches, fruit, and leaves, all of which were gradually destroyed. In cultures, sporangia were not abundant, but oospores were plentiful. Proof was not wanting that the fungus was different from *P. terrestris*.

A. L. S.

Note on Pseudopythium.—F. P. MEERLICH ("*Pseudopythium Phytophthoron*, a Synonym of *Phytophthora Cinnamomi*," *Mycologia*, 1932, 24, 453-4). This fungus is associated with the diseases of pineapple; the writer has found the zoosporangial stages, and the various characters of these agree with *Phytophthora Cinnamomi*, which name now stands.

A. L. S.

Aquatic Fungi.—B. BARNES and R. MELVILLE ("Notes on British Aquatic Fungi," *Trans. Brit. Mycol. Soc.*, 1932, 17, 82-96, 6 text-figs.). The authors were induced to carry out a study of aquatic fungi in this country because so few records had been made. They began by examining the soil of a garden in South London, along with pots of water containing rotting leaves. Among other results three genera have been added to the British flora—*Monoblepharis*, *Gonapodya*, and *Blastocladia*. Cultures of the fungi are still being made of the eleven species that have been identified. *Monoblepharis polymorpha* was found in two widely separated localities and has been successfully cultured. The authors describe the union of the gametes and noted that the female gamete may sometimes begin to emerge from the oogonium before the gametes have completely fused. A list of forty-four books or papers on the subject is appended.

A. L. S.

Study of Saprolegnia.—BESSIE B. KANOUSE ("A Physiological and Morphological Study of *Saprolegnia parasitica*," *Mycologia*, 1932, 431-52, 2 pls.). This fungus is found commonly on fish and fresh eggs in fish hatcheries or in fresh-water lakes and streams; it is a widespread species of *Saprolegnia* in America and Europe. Isolations of the fungus were made and the various aspects of the life-history were studied, etc. The morphology can be controlled by modifications of the environment or by changing the nutritive supply. For the first time oogonia

and antheridia were noted on the mycelium, peptone being found to be the stimulus for sexual reproduction when used with other ingredients also specified. Sexual organs also developed on the mycelium of the fungus when grown on sterilized hemp-seed in water. It was further found that only the asexual type of reproduction occurred in a highly nutritive medium. The question of parasitism of the eggs was also examined; they were scarcely parasitized when few were present, the eggs were rarely penetrated by the parasite. A. L. S.

Notes on Albugo.—B. T. PALM ("Biological Notes on *Albugo*," *Ann. Mycol.*, 1932, 30, 421-6, 3 text-figs.). Palm has made a study of this fungus as it grew on *Tragopogon pratense*, and more especially on the germination of the conidia which produced germination tubes. They may even germinate before the pustules rupture the epidermis and sets them free. He has verified this method of germination in *Albugo Portulacæ*, *A. Blitis*, and *A. spinulosa*. A. L. S.

Study of Thielavia.—C. W. EMMONS ("The Development of the Ascocarp in Two Species of *Thielavia*," *Bull. Torrey Bot. Club*, 1932, 59, 415-22, 2 pls., 1 text-fig.). A new species of *Thielavia*, isolated from the normal skin of a foot, has proved to be new to science—*Thielavia Sepedonium* Emmons. It differs from *Thielavia terricola*, previously described by the author, in several particulars: it grows more rapidly in cultures, it has a conspicuous conidial stage, and there are differences in the ascocarpic development. The asci of the new species arise as simple side branches from the ascogenous hyphæ without crozier formation and without nuclear fusion in the ascus. A. L. S.

Study of Ascobolus magnificus.—H. C. I. GWYNNE-VAUGHAN and H. S. WILLIAMSON ("The Cytology and Development of *Ascobolus magnificus*," *Ann. Bot.*, 1932, 46, 653-70, 3 pls., 13 text-figs.). The development of this fungus had been partially worked out by Dr. Dodge, who had recorded the finding of a new form of spores—papulospores. The new spores were sent to the authors of this paper and their further development is described. These proved to be of two kinds, both of which formed mycelia, which again produced papulospores—infertile in single spore culture but which, when intermingled, gave rise to ascocarps. The further development was followed stage by stage: the formation of antheridia and oogonia and the fertilization stages—the nuclei fusing in pairs in the oogonium; the formation of ascogenous hyphæ, and, finally, of the ascus and the formation of the spores, with their nuclear history. A. L. S.

Study of Cyttaria.—B. T. PALM ("On *Cyttaria* Berk., and *Cyttariella* n.gen.," *Ann. Mycol.*, 1932, 30, 405-20, 4 text-figs.). The new genus *Cyttariella* was collected by Skottsberg in Tierra del Fuego. The family Cyttariaceæ all grow in South America on species of *Nothofagus*. A study of all the specimens has been made and a key as well as descriptions is provided; the general life-history of *Cyttaria* is also followed. The family has been considered by the writer as belonging to the Sphæriales. *Cyttariella* has been created to include two *Cyttaria*-like, pycnidia-bearing stromata. In *Cyttaria* perithecia with asci are formed. A. L. S.

British Xylariaceæ.—JULIAN H. MILLER (*Trans. Brit. Mycol. Soc.*, 1932, 17, 125-46, 3 pls., 1 text-fig.). The paper deals chiefly with the genus *Nummularia*, but Miller has also given an account of *Hypoxyylon* as it occurs in Britain. His descriptions are based on specimens in the Kew Herbarium. A. L. S.

Study of Phoma.—M. GRIMES, M. O'CONNOR, and H. A. CUMMINS ("A Study of some *Phoma* Species," *Trans. Brit. Mycol. Soc.*, 1932, 17, 97–110, 2 pls.). The writers criticize the two genera *Phoma* and *Phyllosticta* as being difficult to differentiate from each other. They were chiefly concerned with species that were isolated from milk. Among these *P. hibernica* was secured by plating samples of milk intended to estimate yeasts, moulds, etc. The species was also secured from cream and butter, and has been temporarily determined as *P. hibernica*. It was carefully developed and a full account is given. Another frequent species, *Phoma destructiva*, was isolated from butter. An account of the various experiments is given; also the substances on which the fungi were grown, and their physiological requirements and reactions. A scheme of classification based on the requirements of the fungi has been devised. A. L. S.

New Fusarium.—A. SARTORY, R. SARTORY, and J. MEYER ("Étude d'un nouveau champignon du genre *Fusarium*: *Fusarium euchelice*," *Ann. Mycol.*, 1932, 30, 471–5, 1 text-fig.). The fungus was isolated from the digestive tube of caterpillars living on groundsel. It was examined and cultured and the different characteristics, including the formation of chlamydospores, are described as they appeared under the different culture conditions. It was judged to be new to science: *Fusarium euchelice*. A. L. S.

Rusts on Apples.—PAUL R. MILLER ("Pathogenicity of Three Red-Cedar Rusts that occur on Apple," *Phytopathology*, 1932, 22, 723–40). The author notes three species of *Gymnosporangium* that occur on apples: *G. Juniperi-virginianæ* (apple rust), *G. germinale* (quince rust), and *G. globosum* (hawthorn rust). These all occurred on the same or on different kinds of apples which are duly listed. Successful inoculations were carried out in the laboratory, and the differences that occurred are given either as to the condition of the infected areas, or the type of æcia, etc., that developed. Successful inoculations were easily produced by *G. germinale* on several varieties of apple, also on quince leaves. Apple leaves inoculated with *G. globosum* and *G. Juniperi-virginianæ* did not produce æcia until the pycnial exudate was mixed, when the majority of the lesions formed æcia. Temperatures and persistence of spores are also given. A. L. S.

Disease of Dahlias.—D. E. GREEN ("Smut Disease of Dahlias caused by *Entyloma Dahliae*," *J. Roy. Hort. Soc.*, 1932, 57, 332–9, 4 pls., 4 text-figs.). The disease made its appearance on the leaves of dahlias in August, on plants that had been raised from cuttings with all due precautions against infection. The symptoms of the disease are described: spots are formed on the leaves which may coalesce and present large diseased areas. The disease was identified as *Entyloma Dahliae*, a smut fungus. The growth and development in all the stages are described and, finally, the methods of dealing with the disease. The origin of the disease is still somewhat obscure. A. L. S.

Hyphal Structure of Fomes.—E. J. H. CORNER ("A *Fomes* with two Systems of Hyphæ," *Trans. Brit. Mycol. Soc.*, 1932, 17, 51–81, 13 text-figs.). Corner, in this study of *Fomes lævigatus* n.sp., found that there were two distinct systems of hyphæ contained in the fruiting body—skeletal hyphæ and generative hyphæ, details of which are included in the diagnoses. The mature fungus is of bracket shape; the skeletal hyphæ are thick-walled and aseptate, the generative are septate, thin-walled and branched, but not clamped. The developing structures are fully described, and all through the paper comparison is made with similar tissues in allied species. Corner has introduced the terms *monomitotic* for

fruit-bodies composed of one system of hyphæ, *dimitic* for those like *Fomes lævigatus* of two systems, and the *trimitic* with three, the latter type occurring in coriaceous species of *Polystictus*, etc.

A. L. S.

New Tricholoma.—A. PILÁT and R. VESETY, Pragæ ("Species nova vernalis generis *Tricholoma*, *Tricholoma Kavince*," *Ann. Mycol.*, 1932, 30, 476-7, 3 pls.). The fungus was first found in Central Bohemia in 1926. In 1932 it appeared in great numbers, a very large species up to 14 cm. diameter and the stalk 10-15 cm. in length, and becoming yellowish. It is good for food.

A. L. S.

Cytological Study of Tulasnella.—DONALD P. ROGERS (*Bot. Gaz.*, 1932, 94, 86-105, 79 text-figs.). The peculiar feature of this genus is the formation at the apex of the basidium of usually four inflated bodies, epibasidia. Into these pass the nuclei and protoplasm of the basal cell followed by a septum across their bases. Mitosis of the nucleus follows, the epibasidium elongates and on a filament, produced from the apex, is borne a binucleate basidiospore. In *Tulasnella Tulasnei* there is no mitosis in the epibasidium. Certain similarities in the basidia suggest relationship with the Tremellaceæ. It is argued further that the epibasidium is the homologue of the ascospore, and the basidiospore so produced represents an ascospore germination-conidium.

A. L. S.

Sexuality in Polyporus.—HÅKON ROBAK ("Ein Polyporaceæ mit Tetrapolärer Geschlechtsverteilung. *Polyporus borealis* (Wahlen.) Fr.," *Svensk. Bot. Tidsk.*, 1932, 26, 266-70, 1 text-fig.). The author publishes this as a preliminary paper on the sexuality of the spores. The first general growth of the spores showed a vigorous formation of mycelium with clamp formations, though the growth from a single spore culture was without clamps. From the latter, fruiting bodies might be built up but produced no spores. Further research revealed the existence of tetrapolar sexuality. It was found also where clamps were formed in the mycelium they differed in the sexual reaction. Robak considers that this is the first determination of tetrapolar sex in *Polyporus*.

A. L. S.

British Fungi.—CARLETON REA ("Appendix II to 'British Basidiomycetæ,'" *Trans. Brit. Mycol. Soc.*, 1932, 17, 35-50, 1 col. pl.). This is the second appendix to the "British Basidiomycetæ," published in 1927, and it introduces a large series of gilled forms new to Britain, with a number new to science, the latter being illustrated. As might be expected, these fungi were collected in the autumn months and are described with full details essential to the student.

A. L. S.

Study of Tulasnella anceps.—MARY J. F. GREGORY ("Observations on the Structure and Identity of *Tulasnella anceps* Bres. & Syd.," *Ann. Mycol.*, 1932, 30, 463-5). This fungus grows on bracken and was met with by the author while making a special study of bracken diseases. In the course of the life-history of the fungus large numbers of sclerotia are developed on the dead bracken fronds. From her observations of the fungus, Gregory has decided that it should be recognized as *Corticium anceps*. The structure is exactly similar to that of *Corticium*.

A. L. S.

Study of Hymenomycetes.—A. A. PEARSON ("Modern Work on the Hymenomycetes," *Trans. Brit. Mycol. Soc.*, 1932, 17, 16-34). A. A. Pearson, President of the British Mycological Society for 1931, chose for his address the group of the Hymenomycetes to which he has devoted much attention for a long period. In comparing fungi with other groups of plants he states that—"Phanerogams of a district can be learned in a relatively short time; the fungus flora is

never exhausted." Pearson has tackled his subject by a survey of the study in the European countries. For each country he reviews the work done by mycologists, especially of the present day, and notes the more prominent workers with more or less criticism of their publications. He points out the line of study that requires to be undertaken by our own and other mycologists; "the work is peculiar," he adds, "in that the members of mycological societies are dealing with species that occur in all parts of the world, but the main object of our forays is to foster an accurate tradition of species and to transmit it faithfully to the next generation."

A. L. S.

Citric Acid Production.—NANDOR PORGES ("Citric Acid Production by *Aspergillus niger*," *Amer. J. Bot.*, 1932, 19, 558-67). After listing the various theories as to the production of citric acid, the author describes the methods he used in its production from *Aspergillus niger* (in a sugar solution of the fungus taken from the soil), the concentration of sugar, the quality of the nitrogen used, NaNO_3 being the most effective for citric acid production. Iron and zinc salts were also necessary for rapid production. Zinc favoured production with the absence of dark spores. The greatest yield of citric acid was obtained after an incubation period of 7 days.

A. L. S.

Chemical Composition of *Aspergillus*.—NANDOR PORGES ("Chemical Composition of *Aspergillus niger* as Modified by Zinc Sulphate," *Bot. Gaz.*, 1932, 94, 197-205). The author found that an addition of zinc (ZnSO_4) to the cultures gave a marked stimulus to the vegetative growth of the fungus, though it repressed spore formation. This increase of growth showed greater utilization of the available sugar with an increase of the dry mycelium and a greater production of oxalic acid.

A. L. S.

Cytology of Fungi.—K. WAKAYAMA ("Contributions to the Cytology of Fungi. IV. Chromosome Number in Autobasidiomycetes," *Cytologia*, 1932, 3, 260-84, 133 text-figs.). Wakayama very unfortunately died before his paper was published. It was seen through the press by Prof. Fugii. The object of the author was to trace nuclear developments in the Autobasidiomycetes. The species examined, thirty-four in number, belong to the families Agaricaceæ, Polyporaceæ, Clavariaceæ, Lycoperdaceæ, and Thelephoraceæ. The species were fixed on the field as soon as collected. Drawings are made of the basidia. Details as to the number of chromosomes, etc., are summarized for each family. The process of nuclear divisions in all its stages has been followed in each specimen and the chromosome number, which varies from 4 to 6, is given in a list of the species examined. Notes are added as to the direction of the spindle of the basidium nucleus; it lies transversely to the axis in the Basidiomycetes, with few exceptions.

A. L. S.

Sewage Fungi.—R. W. BUTCHER ("Contribution to our Knowledge of Sewage Fungus," *Trans. Brit. Mycol. Soc.*, 1932, 17, 112-24, 1 pl.). An account of the fungi met with in the course of investigations on river pollution. The author gives a statement as to the fungi—the group or community which are met with wherever there is a sufficient quantity of certain forms of organic matter supplied from factories, mills, breweries, etc., as well as domestic sewage. The commonest species was *Sphaerotilus natans*, and that fungus, with its allies, has been fully described: it is a filamentous form. Among others noted are *Beggiatoa* spp., several Phycomycetes, and *Fusarium aqueductum*. The relation of the sewage-fungus community to the organic pollution of rivers is discussed; where the water

becomes acid other species arrive, such as *Penicillium fluitans*. Variation in the quantity of organic matter in relation to the distribution of sewage fungi has also been studied. A. L. S.

Mushroom Nutrition.—SELMAN A. WAKSMAN and W. NISSEN ("On the Nutrition of the Cultivated Mushroom, *Agaricus campestris*, and the Chemical Changes brought about by this Organism in the Manure Compost," *Amer. J. Bot.*, 1932, 19, 514-37). The authors state the two aspects of their problem: (1) the transformations of the various organic and inorganic constituents of the manure by the numerous micro-organisms during the process of composting, and (2) the transformations of the constituents of the compost inoculated with spawn until it is spent, changes due primarily to the nutrition of the mushroom. A study was made of the chemical composition of the compost during growth, and also when spent. They found a reduction in compositions of water-soluble substances, but an increase in lignins, total nitrogen, and ash. The growth changes include an increase in the lignin content. They noted a rapid development of fungi and bacteria, and the results of this activity are given: an increase in the lignin content, the nitrogen content, and the ash. The substances used by the mushroom are those which accumulated during composting: "the nitrogenous substances during the process are transformed from an insoluble organic into soluble and mineralized (NH_3) forms." A. L. S.

Study of *Nigrospora Oryzae*.—TR. SĂVULESCU and T. RAYSS ("Der Einfluss der äusseren Bedingungen auf die Entwicklung der *Nigrospora Oryzae* (B. & Br.) Petch," *Phytopathologische Zeitsch.*, 1932, 5, 152-72, 6 text-figs.). This fungus has proved to be very destructive to corn crops in Roumania. A special study of temperature and other influences on spore germination has been carried out by the authors. They found that the spores lost all vitality after two years; observations of temperature showed that germination was rarely under 10° , the optimum lay near 30° ; for the mycelium a higher temperature was desirable, but very high temperatures and dryness were fatal to the spores. A series of experiments on the influence of acids and alkalies on spores is also recorded, and, finally, the statement is made that the spores have an unusual tolerance limit for acids and alkalies and that high temperatures tend to the production of abnormal and resting spores. A. L. S.

Fungi on Hemlock.—B. O. DODGE ("Notes on Three Hemlock Fungi," *Mycologia*, 1932, 24, 421-30, 2 pls., 1 text-fig.). The fungi described developed on some small hemlock trees in the State of New York in bad conditions of growth. No fruiting bodies of fungi were found on the trees, but their dead branches were thickly dotted with conidial fructifications. These were examined and cultured and have been identified as (1) *Dermatea balsamea* (*Cenangium balsameum* Peck). Single ascospore cultures produced pycnoconidia with stylospores. This asexual stage is known as *Gelatinosporium abietinum* Peck. (2) *Myxosporium* sp. (also found on the dying branches) has not been specifically identified as the ascospore stage was absent. (3) *Phomopsis occulta*, the asexual stage of *Diaporthe conorum*. The pathogenicity of the three fungi is being investigated. A. L. S.

New Fungus for the United States.—LEROY DONALD (*Mycologia*, 1932, 24, 455-6). The fungus which forms galls on the stems and leaves of *Veronica arvensis* was discovered to be forming tumours on *Veronica* plants at or near the surface of the ground. A second species, *Sorosphaera radicalis*, has been found in marshes. This is the first record of the genus in the United States. A. L. S.

Elm Diseases.—HUBERT A. HARRIS ("Initial Studies of American Elm Diseases in Illinois," *Bull. Dept. Registr. and Education, Illinois*, 1932, 20, 1-70, 35 text-figs.). The research has determined that the disease of elms in Illinois, though of a serious nature, has no connection with the elm disease in Holland and other European countries. Thousands of elms have been lost in nurseries and many fully grown valuable trees have been killed. The disease is of a fungal nature, and cultures and inoculations have been made from fungi growing on or within the elm-tree bark. It has been shown that elm wilt may be caused by a number of fungi, but the most important in causing disease is a *Coniothyrium*, which penetrates the wood and blocks the water-conducting tissues. Other fungi of importance in causing elm disease are species of *Phoma*, *Sphaeropsis*, *Vermicillaria*, and *Verticillium*. The remedy for the diseases has also been studied: Bordeaux mixture has given good results and careful pruning has also been valuable.

A. L. S.

Cotton Wilt in Mississippi.—L. E. MILES and T. D. PERSONS ("Verticillium Wilt of Cotton in Mississippi," *Phytopathology*, 1932, 22, 767-73, 1 text-fig.). The disease was discovered in the autumn of 1930 and diagnosed as *Verticillium albo-atrum*. It was found by the authors that *Fusarium vasinfectum* also occurred in most cases on the same stalks. Careful listing of these fungi is given: they occur frequently on the same plants, but in many cases it was proved that the *Verticillium* was responsible for the wilting of the cotton.

A. L. S.

Brown-Root Fungus.—E. J. H. CORNER ("The Identification of the Brown-Root Fungus," *Gardens Bulletin, Straits Settlements*, 1932, 5, 317-50, 1 pl., 8 text-figs.). The disease of rubber trees, termed Brown-Root, has been studied by Corner, who finds that it is caused by *Fomes noxius* n.sp., which is a saprophyte in the forest, but is also a facultative parasite. The fungus is compared in detail with allied species; it differs in the form of the hyphæ and in the form of the fruit-body. The neighbouring species are also described and compared.

A. L. S.

New Lichens.—A. ZAHLBRUCKNER ("Neue Flechten—XI," *Ann. Mycol.*, 1932, 30, 427-41). Zahlbruckner publishes diagnoses of nineteen lichens new to science from many parts of the world. One of the most interesting is a plant from N. India of such diverse characters that he finds it difficult to determine its family affinities. The new genus, *Chaudhuria*, is tentatively classified near to *Peltigera* or *Sticta*, because of the blue-green algæ and the spreading thallus; but the peculiarities that differentiate from either of these are the plectenchymatous cortex and the brown septate spores. It was collected on mosses in Darjeeling.

A. L. S.

Lichens of Cézembre.—AD. DAVY DE VIRVILLE ("La répartition des lichens à l'île de Cézembre," *Compt. Rend. Acad. Sci.*, 1932, 194, 1180-82). On the island of Cézembre there are no trees; the lichens are therefore saxicolous or, more rarely, terricolous, such as a few *Cladonia*. On the south side are to be found crustaceous and some foliaceous species. On the north the foliaceous are more developed along with fruticose forms. The strictly marine flora is divided into five zones: (1) *Xanthoria parietina*, (2) *Caloplaca marina*, (3) *Verrucaria marina*, (4) *Lichina confinis*, and (5) *Lichina pygmaea*, the last mingling with the first zones of marine algæ. These zones are larger in exposed situations. Other non-marine species also invade the upper zones.

A. L. S.

Cladonia sylvatica Group.—DR. FRAN KUSAN ("Ueber die angebliche *Cladonia pycnoclada* (Gaud.) Myl. in Jugoslavien," *Hedwigia*, 1932, 72, 42–54). Fran Kusan has given an account of the difficult group of "Cladina" species. She has come to the conclusion that the more recently described species, *C. tenuis*, *C. mitis*, and *C. impeza*, should be regarded as varieties of the older *Cladonia sylvatica*. These have been given specific rank, mainly owing to the presence or absence of certain acids. Kusan considers *C. mitis* as a particularly weak species that is only to be determined by taste—all bitterness being absent. *C. pycnoclada* she accepts as a distinct species owing to its lucidity caused by the absence of the cell layer round the medulla ("couche medulaire exterieure"). A. L. S.

Lichens of South Lapland.—GUNNAR NILSSON DEGELIUS ("Zur Flechtenflora des Südlichsten Lapplands" (Åsele Lappmark). I. Strauch und Laubflechten, *Ark. för Bot.*, 1932, 25, 1–72, 1 map, 8 text-figs.). The country studied by Degelius is the southernmost part of Lapland. He gives a description geological and climatic, and finds three zones, Alpine, subalpine, and "sylvatic," the latter the only pine region including birch, poplar and willow, etc., all of which are lichenologically important. The other regions are also described. Then follows the list of lichens found. In earlier literature fifty-seven leafy and shrubby lichens had been known. As a result of this more recent research 170 species are now recognized. Crustaceous lichens have not been included. The northern genera and species are well represented, *Cladonia* being specially abundant. The different localities are given and a list of the literature consulted. A. L. S.

Occurrence of *Parmelia caperata*.—GUNNAR NILSSON DEGELIUS ("Nordiska Fyndorter för *Parmelia caperata* (L.) Ach.," *Svensk Bot. Tidsk.*, 1932, 26, 333–45, 2 text-figs.). The author records the first-known occurrence of *Parmelia caperata* in Östergötland (Sweden) in 1822. It is rarely found in these northern countries: four records in Sweden, eight in Norway, four in Denmark, and none in Finland. He considers this rare species rather as a relict of the first glacial period of warmth than as a recent importation, and he classifies it along with *Parmelia conspersa* in the Section *Xanthoparmelia*. A. L. S.

***Parmelia conspersa*.**—DR. FRAN KUSAN ("Ueber die Systematische Bewertung Gewisser Merkmale im Formenkreise von *Parmelia conspersa* sensu lat.," *Acta Bot. Inst. Bot. Univ. Zagreb.*, 1932, 7, 1–32). In this study of *Parmelia conspersa*, as found in Jugoslavia, Fran Kusan has examined the new species, varieties, and forms published by Gyelnik. She comments first on the yellowish colour as a distinct character of the plant though it may vary to brown; the thallus varies also in the production of the lobules; she notes further the almost constant production of isidia, mainly cylindrical in form, though these also vary as to number, the production being influenced by outward factors, their presence or absence indicating a more or less constant variation. The apothecia are fairly constant in all the different groups. Considerable attention has been given to the chemical reactions which are influenced by various factors, and in all cases too much stress should not be laid on the constancy of the colours formed by the reagents. Finally, the many species and forms have been grouped by her under *P. molliuscula* and *P. conspersa*, two closely related species, with a series of varieties and forms. The publication of the many species and forms is deprecated by the writer. A. L. S.

Lichens from the Adige.—MARIA CENGIA-SAMBO ("Il microclima di una valle alpina attraverso i Licheni. Osservazioni fitogeografiche nella Campagna

lichenologica in Val Badia (Alto Adige) 1931," *Arch. Bot.*, 1932, 8, 193-206). Val Badia is a high valley of the Adige and is traversed by the Gadeo torrent from south to north. It is crossed by Val Parola, Val Riolorto, and Val Pisciadu, and the author has studied the lichens of these three valleys in every aspect of direction, altitude, climate, and habitat. Each valley is examined in turn; the lichens are described and comparisons are made, and reasons given for the prevalent lichen growth at every stage. A. L. S.

New or Rare Lichens.—C. F. E. ERICHSEN ("Lichenologische Beiträge II," *Hedwigia*, 1932, 72, 75-91, 1 map, 1 text-fig.). Erichsen gives an interesting account of new species and varieties of lichens from Northern Germany. One of the most striking, *Physcia ocellata*, without apothecia but with deep orange soralia with white farinose margins, the whole structure lecanorine in appearance. Its nearest affinity was *Physcia irrelata*. A new species of *Lecanora* (*Aspicilia*) is described by Magnusson and also a variety of *Lecanora atra* (var. *muralis*) which also approaches the *Aspicilia* type of development. A. L. S.

Lichens of Hugó Lojka.—O. SZATALA ("Lojka Hugó hágyatékanak zsumoi. Lichenos a divo H. Lojka relictæ," *Magyar Bot. Lapok*, 1932, 31, 67-126). Szatala has reviewed the work done for lichens by Lojka, who died forty-four years ago. He gives an account of his life and of the various expeditions made by him in his study of lichens, and he dwells on Lojka's critical faculty in the distinguishing of species. His collections were bought by the Museum of Vienna and the Hungarian lichens were entrusted to Szatala for examination and determination. They included specimens collected from the Hungarian Central Mountains, North, East, and South Carpathia, Banati, Transdanubia, and Croatia. A very long series of these plants have now been published by Szatala. Various novelties are included, mostly new varieties and new combinations. A. L. S.

Hungarian Lichens.—V. GYELNIK ("Enumeratio lichenum europæorum, novorum, rariorumque," *Ann. Mycol.*, 1932, 30, 442-55). Gyelnik has published the results of an examination of the lichens in the Hungarian National Museum, many of them not previously determined. He has described also many new varieties and forms in the genera *Parmelia*, *Agyrophora*, and *Gyrophora*. Among other notes he calls attention to the difference of colour in certain lichen-thalli according to habitat. Thus *Parmelia physodes*, which is a grey-green on leafy trees, is bright green on Pines; these have been described as true forms. These colours disappear in one or two years in herbaria. He has found the same difference in *P. caperata*, *P. saxatilis*, *Parmeliopsis diffusa*, and *Bæomyces rufus*, all more brightly green on pines.

Genus Parmeliopsis.—V. GYELNIK ("Ueber einige Arten der Gattung *Parmeliopsis*," *tom. cit.*, 456-9). Varieties in form and colour of the thalli. These are described under varieties and forms new to science. A new American species, *P. marylandica*, is also described. A. L. S.

Lichens of Victoria Falls.—OVE ARBO HOEG ("A Note on the Character of the Lichen Flora at Victoria Falls," *Kong. Norske Vidensk. Selsk. Forhandl.*, 1931, 4, 93-5). Hoeg has made a study of the lichen flora of the very moist region in the near neighbourhood of the Victoria Falls in South Africa. The continual moist air differs so entirely from the general aridity of the country there that he suspected the lichens might probably prove to be relics of some great forest of a previous era. He found no evidence for this. There is considerable absence of light in the dense vegetation which itself is unfavourable to lichen growth. He

has suggested that there never has been a continuous tropical forest, and also the form and position of the Falls, owing to their own erosion, must have greatly changed during the ages. The lichens found were widespread species.

A. L. S.

African Bark Lichens.—RUDOLF RIEHMER ("Eine Ökologie afrikanischer Rindenflechten," *Arch. Protistenkunde*, 1932, 76, 338–94, 3 pls., 10 text-figs.). Riehmer gives a list of thirty-eight corticolous species, which he has examined with a view to following their development under varying conditions: he notes first the dense coating of lichens on the trees, and the greater abundance of crustaceous forms. The factors of solitary or united growth are described, both of which are influenced by the presence of water, not only as to vegetative but also to reproductive abundance. He notes also as important the action of wind, of light, and shade on growth and colouring. As an instance of the reaction to these conditions he gives a detailed description of *Lecanora leprosa* in light (greenish-white) and in shade (grey- to blackish-brown). The formation of soredia as influenced by these factors comes also under review, then the constant competing growth of species, the weaker thalli being overgrown by the stronger. As an example *Pertusaria* sp. is cited as a strong-growing lichen which spreads over other crustaceous species altering the form and often destroying as it proceeds. Gonidia had also wandered into the hymenium singly or in groups. The overgrowing by leafy and shrubby lichens is also described and the relation of these to their substratum. Special attention is given to the influence of corticolous lichens on their special substratum. Riehmer has gone into the question carefully. Many times the lichen hyphæ on bark are so intimately associated with the host-cells that with the increase of their number and size the lichen tends to a splitting of the substratum; they never pierce the living cells though loose periderm cells may become imbedded in the lichen tissue. Riehmer describes the mosaic that arises from the closely packed, mixed species; he considers *Lecanora leprosa* as one of the most vigorous examples of forceful growth. On the bark examined, he counted fifty-two specimens of that lichen; *Buellia Zahlbruckneri* came next with twenty-eight thalli. At a later stage the leafy or shrubby forms arrived, chiefly *Parmelia perforata* and *Usnea florida*, and these larger forms became finally dominant. Further notes are given as to development from soredia or from thalline particles. Three new species are described by the author—*Pertusaria subochrascens* Riehm., *Buellia Tobleri* A. Zahlbr., and *B. crassa* Riehm.

A. L. S.

Study of Stereocaulon.—M. and MME. F. MOREAU ("Sur un Lichen du genre *Stereocaulon* Schreb. le *S. coralloides* Fries," *Bull. Soc. Bot. France*, 1932, 79, 508–515, 5 text-figs.). The authors have studied the general growth of *Stereocaulon*, noting the solid stalks which differentiate the genus from *Cladonia*; they have also given descriptions of the cephalodia and of the stalk squamules. The formation of the fertile bodies is reviewed. They originate at or near the apex of a podetium where are formed minute clumps of ascogonial hyphæ uninucleate and united by a central protoplasmic strand. A slender trichogyne is often present, but it gradually degenerates. The maturing apothecium is a naked disc with septate paraphyses, at their base the ascogenous hyphæ; later these hyphæ are binucleate with hooks on the side. The asci take origin as croziers at the end of a short chain of binucleate cells rising from a mycelium with hooks; the spores are fusiform and septate. The authors consider that their study has confirmed the view that the lichen is an algo-ecidium—a gall condition of fungus on alga.

A. L. S.

Lichen Biology.—MARIA CENGIA-SAMBO ("Biologie des Lichens. Les Substances carbohydratées dans le Lichens et la Fonction de Fixation de l'Azote des Cephalodes," *Bollett. Sez. Ital. Soc. Intern. Microbiologia*, 1931, Fasc. XI, 1-8). The author recapitulates and reaffirms her discoveries and views on the biology of lichens which she has been publishing for some years. She found in her researches that starch was not present in the green gonidia, but that oil was there and that glycogen occurred in the asci of lichens. In blue-green gonidia the first substance detected was glucose—and in the symbiotic condition there was present a nitrogenous bacterium belonging to the genus *Azotobacter* present also in the cephalodia, these being able to fix nitrogen and thus serving the same purpose as the bacteria in the root-nodules of Leguminosæ. A. L. S.

Development of Lichen Thallus.—T. TOBLER ("Zur Entwicklungsgeschichte des Flechtenkörpers," *Ber. Deutsch. Bot. Ges.*, 1932, 50, 237-47, 8 text-figs.). Tobler sets before us the relations between fungus and alga in the formation of the lichen thallus with special reference to the combined growth of *Lobaria laciniata* (*L. amplissima*) and its cephalodium, which had been determined by Nylander as a separate plant—*Dendriscoaulon bolacinum*. Its presence is easily detected by the upright branching formation and by the dark colour due to the blue-green gonidium. Tobler also calls attention to the presence of parasitic fungi where we have a different fungal organism preying on the lichen alga. A point emphasized is that surrounding conditions may not favour the growth of the cephalodium: it is absent from North American specimens. Differences occur also in the form of the cephalodia and of the host thallus when the algæ of one or the other predominates. In cultures it was found that the blue-green algæ lagged behind in development, and that the green thallus had a richer growth. The cephalodium, as already stated, was determined by Nylander as *Dendriscoaulon bolacinum*, an independent lichen growth. Tobler inclines to accept Nylander's views. In Norway it has been noted that the *Lobaria* grows more vigorously when the cephalodia are absent. Tobler also emphasizes the importance of the thallus in systematy: the fruit being insufficient, a fact more particularly noticeable in such variable plants as the *Cladonia*. A. L. S.

Notes on Lichen Gonidia.—A. DE PUYMALY ("Observations et remarques sur les lichens," *Compt. Rend. Acad. Sci.*, 1932, 194, 1600-02). Puymaly has observed that lichens grow in the localities where the gonidia as free-living algæ are congregated. Thus *Graphidæ* follow the *Trentepohliæ*, and similarly soil, rock, or tree algæ are united with the lichens that select the same substratum. He concludes that the gonidium draws nutrition from the same substances as the alga, that the lichen must live with its partner, and thus the gonidium directs the ecology of the lichen. It is not a matter of simple symbiosis. A. L. S.

Notes on Elfving's Views.—F. TOBLER ("Elfving's Untersuchungen über Flechtengonidien," *Hedwigia*, 1932, 72, 68-74). Tobler has gone carefully over Elfving's attempt to prove that the lichen gonidia are produced from the lichen hyphæ first as a small round "dygonidia," in the slime of disorganized hyphæ, and declares that these become mature gonidia. Elfving claims that in cultures he has induced this gonidial formation. In *Stictina* he has similarly claimed to have followed the development from groups of hyphæ to clumps of blue-green algæ. Tobler has pointed out where these statements are lacking in precision and demands more decisive proof. A. L. S.

Soralia and Isidia of Cladoniæ.—E. BACHMANN ("Ueber Sorale, Isidien und ähnliche Wucherungen auf *Cladonia*," *Arch. Protistenk.*, 1932, 77, 1-57, 87 text-figs.). Bachmann in this paper has dealt with the outside growths of thallus and podetia in *Cladoniæ*. These bodies are formed most freely when the conditions supply over-production of the lichen symbionts on the surface: the medulla has small part in their formation. The different kinds of soralia are described: flat, round, or angular and generally formed at a bend of the podetium, and on the convex side, the place of most active growth. On the surface they are generally powdery or sometimes resemble a blackberry in form. The soralia of *Cladonia strepsilis* are dark in colour, owing to the adherence of the older gonidia which die in situ. Isidia occur on the podetia of *C. Floerkeana* and *C. rangiformis* f. *isidiophora*; they are coralloid in form. Bachmann notes also that when green algæ alight on *Cladoniæ*, the fungal hyphæ grow freely and surround the alga. If Cyanophyceæ, the hyphæ resist their settlement and succeed in rejecting these foreign bodies. Many details are given and figured of the form of the soralia and isidia and their connection with the tissues from which they are formed. The author of the paper has died recently.

A. L. S.

Epiphytic Lichens.—C. FREIHERR VON TUBEUF ("Bekämpfung von Flechten und Moosen, besonders in Baumschulen und Forstgärten," *Zeitschr. Pflanzemkr. u. Pflanzensch.*, 1932, 42, 470-9, 4 text-figs.). Tubeuf points out that lichens are not parasites but are epiphytic on the bark and also on the leaves of trees. They are not to be found on year-old trees in nurseries, but they are present at older stages. They do some damage by harbouring insects, etc., and as they retain water they give rise to swellings on smooth bark. It is recommended that spraying with Bordeaux mixture should be used: it kills completely the lichen growth.

A. L. S.

Association of Clavariæ with Algæ.—B. T. PALM ("Clavarien und Algen," *Svensk. Bot. Tids.*, 1932, 26, 175-90, 2 pls., 4 text-figs.). The association of algæ with *Clavariæ* has long been known. Palm has been incited to a new study of the relationship between the two organisms by the study of species with an underground sclerotium collected in Sumatra and in Guatemala. He has described and figured the close attachment of alga and fungus in the sclerotium, which he considers lichenoid in character: the alga seems to receive no harm. The writer describes the various associations in the Basidiolichens. Finally, he concludes that this association is not to be classified as a lichen, but that the so-called "lichen" is to be regarded as a sclerotia-forming fungus with the alga as the host-plant.

A. L. S.

Mycetozoa.

Mycetozoa in Ireland.—G. LISTER ("Mycetozoa of the Belfast Foray," *Trans. Brit. Mycol. Soc.*, 1932, 17, 14-15). About twenty-five different species of Mycetozoa were collected during this Irish Foray, two species being new records for Ireland. The ground covered is described by G. Lister. Most of the finds were on old logs and stumps: the season was rather too early for Mycetozoa.

A. L. S.

NOTICES OF NEW BOOKS.

Zeiss Nachrichten.—Edited by Prof. F. HAUSER. Part I. July, 1932. 32 pp., 23 figs. Published by Carl Zeiss, Jena, Germany.

The History of the Microscope, Compiled from Original Instruments and Documents, up to the Introduction of the Achromatic Microscope.—By REGINALD S. CLAY, B.A., D.Sc., F.Inst.P., F.R.M.S., and THOMAS H. COURT. 1932. xiv + 266 pp., 164 illustrations. Published by Charles Griffin & Co., Ltd., 42, Drury Lane, London, W.C.2. Price 30s. net.

Faune de France. Vol. 24. Tardigrades.—By L. CUÉNOT. 1932. 96 pp., 98 text-figs. Published by Paul Lechevalier, 12, Rue de Tournon, Paris (VI^e). Price 35 fr.

Methods in Plant Histology.—By CHARLES J. CHAMBERLAIN, Ph.D., Sc.D. 5th revised edition, 1932. xiv + 416 pp., 140 text-figs. Published by the University of Chicago Press, Chicago, Illinois, U.S.A. Obtainable from Cambridge University Press, Fetter Lane, London, E.C.4. Price 18s. net.

A Manual of Bacteriology, Medical and Applied.—By R. T. HEWLETT, M.D., F.R.C.P., D.P.H., and JAMES MCINTOSH, M.D., B.Ch. 9th edition, 1932. ix + 746 pp., 43 plates, 66 text-figs. Published by J. and A. Churchill, 40, Gloucester Place, Portman Square, London, W.1. Price 18s. net.

Industrial Microscopy.—By WALTER GARNER, M.Sc., F.R.M.S. 1932. vii + 389 pp., 208 figs. Published by Sir Isaac Pitman & Sons, Ltd., Parker Street, Kingsway, London, W.C.2. Price 21s. net.

British Museum (Natural History).—Instructions for Collectors, No. 12. Worms. 1932. 22 pp., 19 figs. Published by the British Museum (Natural History), Cromwell Road, London, S.W.7. Price 6d.

Mikroskopie für Jedermann.—By Dr. G. STEHLI. 2nd edition, 1932. 72 pp., 113 text-figs. Published by Franckh'sche Verlagshandlung, Stuttgart, Germany. Price RM. 2.80.

Recent Advances in Forensic Medicine.—By SYDNEY SMITH, M.D., M.R.C.P., D.P.H., and JOHN GLAISTER, Jr., M.D., D.Sc., J.P. 1931. vi + 194 pp., 66 illustrations. Published by J. and A. Churchill, 40, Gloucester Place, Portman Square, London, W.1. Price 12s. 6d. net.

The first part of this book is devoted to firearms, and as there is very little printed in English on this subject, this section is valuable. The first chapter considers the various kinds of wounds to which a firearm may give rise. The information is accurate, but deals principally with pistols and other low-velocity weapons. Burrard's theory of cavitation velocity is not mentioned.

Some fifty pages are devoted to the identification of firearms, projectiles, empty cases, and propellants, while the section on empty cases is clear and adequate. The importance of photographing the breech face is mentioned, as is also the

unreliability of the depth of the strike pit. Short tables of the commoner cartridges and weapons are also added.

The section on the chemical examination of propellants is rather too sketchy to be of any real value. The polariscope is entirely neglected, and a defect in this part of the work is the paucity of references. None is given of the work of Drs. Mezger and Heess and Inspector Haslachner, nor to the chapter on firearms in Lucas's "Forensic Chemistry." Dr. Wilbert Huff's work on the cause of after corrosion, with its revolutionary effects on the design of primers, and his later work on corrosion under oil, are of considerable importance, but are not mentioned.

The next section of the book, dealing with the examination of hairs, contains a large number of photomicrographs, which are likely to be of more interest to the lawyer than to the scientist. A description of the preparation of slides is included, and renders this section of the work complete.

A valuable section on the precipitin test is included, and full details of the technique are given, but it is curious that, while mention is made of the possibility of antisera being too strong, no mention is made of the law of optimum proportions. Brief reference is made to other tests based on the same principle for the presence of semen, bone, and muscle.

Blood groupings are fully dealt with in the concluding chapters, as are also the estimation of CO_2 in blood, the use of the spectroscope and ultra-violet light, and the estimation of alcohol in blood and urine.

The work is well printed and illustrated.

L. P. C.

Principles of Soil Microbiology.—By SELMAN A. WAKSMAN. 2nd revised edition, 1931. xxviii + 894 pp., 8 figs., 15 plates. Published by Baillière, Tindall and Cox, 8, Henrietta Street, Covent Garden, London, W.C.2. Price 52s. 6d. net.

In this book the known facts concerning micro-organisms met with in the soil and their activities have been collected and are presented to the reader as a connected story. The literature of the subject, now a very extensive one, has been searched and abstracted, an attempt is made to interpret the facts that have been gathered, and various further lines of investigation needed and notes where additional information is wanted, are indicated. The subject is an extraordinarily complicated one, dealing as it does with so many classes of living organisms—bacteria and yeasts, algæ and fungi, protozoa and rotifers, flat and round worms, annelids and arthropods, arachnids and myriapods, insects and molluscs, and others, all of which play a part in the transformation of inorganic and organic matter which influences the physical, chemical, and other characters of the soil. Methods of investigation are detailed, the various classes of organisms are described, and their importance to the agriculturist is indicated. The book is a storehouse of information and everywhere references to the original papers are given, and it may be regarded not only as an exhaustive and authoritative text-book but also as an introduction to further research.

R. T. H.

The Invertebrata.—A Manual for the Use of Students.—By L. A. BORRADALE and F. A. PORTS; with chapters by L. E. S. EASTHAM and J. T. SAUNDERS. 1932. xiv + 645 pp., 458 text-figs. Published by the Cambridge University Press, Fetter Lane, London, E.C.4. Price 25s. net.

Teachers and students will be grateful to the Cambridge zoologists for a new text-book on the Invertebrata sufficiently comprehensive to form a basis for Honours work and yet of a reasonable price.

It was time that such a book was put on the market, for during the last thirty years the standard text-books used by Honours students of zoology have got sadly out of date, and the attempts to put some new wine in these old bottles have not been very successful. But where the ground pattern of structure differs so greatly as it does between the phyla of the vast assemblage of animals grouped together as "invertebrates," the task of the compiler of a new book is extraordinarily difficult; and one can scarcely be surprised that no British zoologist has hitherto had the courage to attempt it during the present century.

The Cambridge text-book takes for granted that the reader has already spent at least a year on the study of zoology, and it deliberately omits descriptions of the animal types dealt with in the more elementary manuals. The authors wisely try to avoid "type-teaching," and, so far as possible, each group of animals is studied comparatively. Every specialist will, of course, raise the complaint that the section in which he is mainly interested is too short or too scrappy; and obviously the particular interests of the authors themselves have partly dictated the allotment of the space devoted to the several phyla. The student of the Echinodermata will certainly be far from satisfied with his share; and the inclusion in this volume of the protochordates (justifiable though it may be on certain grounds) seems doubtful wisdom since it has involved the occupation of valuable space by what, in the reviewer's opinion, is no more than an introduction to their study. But at least the protozoologist will rejoice to see that his animalcules get their very fair share of attention and are treated as though they were, from the view-point of classification, on a par with the Metazoa; they are no longer dismissed in a few crowded pages illustrated by smudgy figures from the Victorian past. And, as was to be expected, the sections on coelenterates and on annelid worms are remarkably comprehensive and satisfying.

The book's scope admits little beyond the main features in morphology and classification, together with the outlines of life-histories. At times this makes pretty dry reading, one must admit. For his physiology and embryology the student must go to other books. And it strikes the reviewer that, if the book is to form the basis for further study, it is a pity the authors have not given at the end of each section a list of works that might be consulted for information on these other aspects of the subject and of works dealing more fully with the morphology itself. For, while the book is doubtless quite adequate for the man preparing for Part I of the Tripos, for instance, it is not nearly detailed enough for those who pursue their studies beyond that stage, nor for those whose interest and curiosity would urge them to wider reading if they knew how to set about it without consulting their teachers directly.

D. L. M.

Foraminifera, Part I. The Ice-Free Area of the Falkland Islands and Adjacent Seas.—By EDWARD HERON-ALLEN, F.R.S., and ARTHUR EARLAND, F.R.M.S. 1932. (*Discovery Reports*, Vol. IV, pp. 291-460, plates VI-XVII.) Published by the *Discovery* Committee, Colonial Office, London. Obtainable from Cambridge University Press, Fetter Lane, London, E.C.4. Price 25s. net.

This report deals with a very extensive area lying between 48-50° S. and 57-68° W., comprising Cape Horn and the Falkland Islands, mostly within the 100 fathoms line. One new genus, *Patellinoides*, is described, and placed in sub-family *Rotaliince*, being an intermediate genus between *Spirillina* and *Patellina*. The report records 419 species and varieties, of which about forty are new to science. D'Orbigny in his voyage to South America collected material in the Falkland Islands, and on his return to France published his monograph of the

Foraminifera of that district in 1839. The authors of this report have attempted to verify the determination of their specimens of the d'Orbigny species recorded in his report by comparing them with the original type specimens. They found that many of d'Orbigny's species have no specific value. They are, at best, the local forms of other well-known and older species; but the authors have, in this report, for the most part accepted them for reasons of history and sentiment, while pointing out their affinities to better known forms.

It is impossible in a short notice to deal adequately with a report of this length. It is clearly expressed, and deals with the subject-matter in the authors' usual masterly manner, and they are to be congratulated on the production of a work of such outstanding merit.

The writer has had the privilege of examining a large number of the species from the *Discovery* stations, and can speak from personal knowledge of the accuracy of the plates illustrating the report.

F. W. M.

The Microscope (Ultra-violet Edition—15th).—By SIMON HENRY GAGE, Professor of Histology and Embryology at Cornell University. 1932. 589 pp., 291 text-figs. Published by the Comstock Publishing Company, Ithaca, New York, U.S.A. Price \$4.00.

This latest edition of the above work is similar to the earlier editions, and contains information chiefly of a practical character likely to be helpful to the microscopist; this side of the subject is clearly presented and well illustrated. There is, however, a lack of theory in support of the practice throughout the treatise; to quote only one instance—the subject of the resolving power of the objective appears to have been entirely neglected. There is a welcome section on dark-ground illuminators and also one dealing with the spectroscope as used in conjunction with the microscope; methods of using and applying these accessories are described together with experiments to illustrate their respective effects. The chapter on the polarizing microscope is disappointing; more than half this section is taken up with an elementary treatment of simple lenses, aberrations, refractive indices, numerical aperture, which have little or no direct bearing on polarization and which should have appeared elsewhere. Moreover, there is little information given regarding either the correct optical systems and accessories of a polarization microscope or of the application of the instrument. The important determination of the bi-refringence of any structure together with the methods of doing this, are both overlooked; nor is there any mention of the examination of specimens in "convergent" polarized light. Considerable space is devoted to the preparation and mounting of microscope specimens, and the very detailed account given here should be of interest to many workers. A chapter also appears on photography and photomicrography, and a useful one on the interpretation of the image.

The special feature of this edition, however, according to the author, is the inclusion of information relating to ultra-violet microscopy, to which a rather brief chapter is devoted. His view of this subject is confined to the illumination of the object with ultra-violet light and to observation of the fluorescent effects with an ordinary microscope having a glass optical system. The more generally recognized purpose of using ultra-violet light with the microscope, is that of attempting to increase the resolving power of the instrument by using radiation of a shorter wave-length than the visible spectrum. Of this more important side of the subject, the recent methods employed, and the results obtained, no mention is made at all. As the book is specifically entitled "Ultra-violet Edition," one would have expected to have found a much more informative section allotted to this part of the subject. In this last respect the book fails in its purpose.

B. K. J.

PROCEEDINGS OF THE SOCIETY.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD IN THE HASTINGS HALL, BRITISH MEDICAL ASSOCIATION HOUSE, TAVISTOCK SQUARE, LONDON, W.C.1, ON WEDNESDAY, OCTOBER 19TH, 1932, AT 5.30 P.M., MR. CONRAD BECK, C.B.E., PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the President.

New Fellow.—The following candidate was balloted for and duly elected and, having subscribed his signature to the Roll, was admitted by the President to the Fellowship of the Society :—

Leslie Stephenson Hiscott, Richmond.

Nomination Certificates in favour of the following candidates were read for the first time, and directed to be suspended in the Rooms of the Society in the usual manner :—

Ronald J. Bracey, F.Inst.P., London.
 Sir Aldo Castellani, K.C.M.G., M.D., F.R.C.P., London.
 Edna Charlton, B.Sc. (Durham), Ealing.
 Edward Frankel, Jr., M.D., F.A.C.S., New York.
 Roy Fraser, M.A. (Kansas), B.S.A. (Toronto), Sackville, N.B.
 Albert C. A. Leurquin, LL.D., Brussels.
 William H. North, Thames Ditton.
 Rubugunde M. Row, B.A. (Madras), London.
 Peter K. Sartory, Ealing.
 Frederick J. Tanner, Bournemouth.

Deaths.—The President announced the deplorable loss the Society had sustained by the passing of Mr. A. Chaston Chapman, whose death on October 17th last, in his sixty-third year, had deprived the Society of a distinguished Past President, whose outstanding personality and eminent services to micro-biological science the Fellows present gratefully acknowledged by standing in silence.

The President also regretfully announced the deaths of the following Fellows, and votes of condolence with the relatives were passed :—

J. H. V. Charles. Elected 1921.
 A. E. Charlton. Elected 1922.
 W. Hepworth-Collins. Elected 1889.
 Joseph Kitchin. Elected 1905.
 Joseph H. Scott. Elected 1916.

Donations were reported from :—

Messrs. Chapman & Hall, Ltd.—

“Microchemical Laboratory Manual.” By F. Emich. Translated by F. Schneider.

Messrs. J. and A. Churchill—

“Recent Advances in Forensic Medicine.” By S. Smith and J. Glaister.

Messrs. Charles Griffin & Co., Ltd.—

“The History of the Microscope.” By R. S. Clay and T. H. Court.

Cambridge University Press—

“Methods in Plant Histology.” 5th revised edition. By C. J. Chamberlain.

Egyptian University Library—

“The Food of Protozoa.” By H. Sandon.

M. Paul Lechevalier—

“Faune de France, Vol. 24. Tardigrades.” By L. Cuénot.

Mr. A. Earland, F.R.M.S.—

“Thoughts on Animalcules.” By G. A. Mantell.

Mr. E. Heron-Allen, F.R.S., F.R.M.S., and Mr. A. Earland, F.R.M.S.—

“Foraminifera, Part I. The Ice-Free Area of the Falkland Islands and Adjacent Seas.” By E. Heron-Allen and A. Earland.

Mr. F. W. Mills, F.R.M.S.—

“Die Ceratien.” By E. Jörgensen.

“Die südrussischen Neogenablagerungen, Part 3. Sarmatische Stufe.” By N. Andrusov.

Dr. C. Tierney, F.R.M.S.—

“London and the Advancement of Science.” By various authors. 1931.

“The British Association for the Advancement of Science: A Retrospect, 1831-1931.” By O. J. R. Howarth. Centenary (second) edition.

Mr. Wm. Sanderson—

Portraits of Hugh Powell and Thomas H. Powell.

Society of Arts Silver Medal awarded to Hugh Powell, 1841, for his microscope design.

2 Antwerp Exhibition Medals, 1891, awarded to Powell and Lealand.

1 Simple Hand Microscope in case.

Mr. W. R. Traviss—

The Original Traviss Expanding Stop.

The Royal Society—

£150 (One hundred and fifty pounds).

Hearty votes of thanks were accorded to the donors.

Papers.—The following paper was communicated by Dr. C. Tierney :—

Dr. Peter Gray, Ph.D., A.R.C.S.

“ A Rapid Technique for the Permanent Mounting of Minute Freshwater Organisms.”

A communication, “ Suggestions for a New Series of Objectives,” was then read from Mr. G. Dallas Hanna, in which he expressed the view that the materials were now available for the computation of a series of objectives having a numerical aperture of 1·7–1·75 for parts of the visible spectrum, and he referred especially to mounting media and immersion fluids of high refractive index.

In the discussion which followed the President drew attention to the very great step in advance already made by the manufacture of quartz lenses having an N.A. comparable to approximately 2·4 in ultra-violet light, and further observed that the subject had already been considered by the British Scientific Instrument Research Association, and he invited Mr. Bracey, who was present, to indicate to what extent they had gone in producing an object-glass of high numerical aperture.

Mr. Bracey observed that the work done at the British Scientific Instrument Research Association in the direction of increasing the numerical aperture and consequent resolving power of microscope object-glasses might perhaps be mentioned. A design for a lens of N.A. 1·60 has been completed. The following facts have been taken into consideration.

Since mounting media which are available for bacteriological work have not a higher refractive index than 1·33–1·4, it is quite clear that it would be useless to design a lens of as high an aperture as 1·6 for bacteriological work. On the other hand, the metallurgist might profitably use a lens of numerical aperture of 1·6 provided that such a lens were suitably corrected for use with a vertical illuminator.

Glasses and crystalline material of high refractive index usually have, at the same time, a high dispersive power. If one contemplates making microscope object-glasses using such high refractive index materials, serious difficulties will occur in removing chromatic aberration. These considerations led to the preparation of a design for a monochromatic lens, i.e. a lens usable only with monochromatic light.

The object-glass was designed for metallurgical work for use with the mercury blue line 4359 Å.U. and a monobromo-naphthalene-xylene mixture as an immersion fluid. This object-glass had a numerical aperture of 1·6, and was corrected for the usual aberrations and, in addition, specially corrected so as to be capable of being used to the best advantage with a vertical illuminator. This lens would have a resolving power of about 187,000 lines per inch.

If there were no question of the durability of high refractive index glass or of the stability of a methylene diiodide immersion fluid, little difficulty would be found in increasing the N.A. of monochromatic object-glasses up to 1.70.

Mr. Bracey added that it should be remembered that the monochromatic blue illumination of the objects under the microscope would be very tiring to the eye, and that in addition all the advantages of colour perception would be lost.

Votes of thanks were accorded to the authors of the foregoing communications, and to Mr. Bracey for his remarks.

Exhibit.—Mr. Barnard exhibited and described some recent specimens of infectious ectromelia, and also some lantern slides of the virus photographed in ultra-violet light.

A vote of thanks was accorded to Mr. Barnard for his exhibit.

Announcement.—The President announced that the Biological Section would meet in the Pillar Room on Wednesday, November 2nd, 1932.

The Proceedings then terminated.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD IN THE HASTINGS HALL, BRITISH MEDICAL ASSOCIATION HOUSE, TAVISTOCK SQUARE, LONDON, W.C.1, ON WEDNESDAY, NOVEMBER 16TH, 1932, AT 5.30 P.M., MR. CONRAD BECK, C.B.E., PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the President.

New Fellows.—The following candidates were balloted for and duly elected Ordinary Fellows of the Society :—

Ronald J. Bracey, F.Inst.P., London.
Sir Aldo Castellani, K.C.M.G., M.D., F.R.C.P., London.
Edna Charlton, B.Sc. (Durham), Ealing.
Edward Frankel, Jr., M.D., F.A.C.S., New York.
Roy Fraser, M.A. (Kansas), B.S.A. (Toronto), Sackville, N.B.
Albert C. A. Leurquin, LL.D., Brussels.
William H. North, Thames Ditton.
Rubugunde M. Row, B.A. (Madras), London.
Peter K. Sartory, Ealing.
Frederick J. Tanner, Bournemouth.

Nomination Certificates in favour of the following candidates were read for the first time, and directed to be suspended in the Rooms of the Society in the usual manner :—

Prof. T. K. Koshy, M.A. (Madras), London.
Dr. L. R. Waldron, Fargo, N. Dakota.

The Death was reported of :—

Prof. Viktor H. Langhans. Elected 1930.

A vote of condolence with the relatives was passed.

The following **Donations** were reported, and hearty votes of thanks accorded to the donors :—

Messrs. J. and A. Churchill—

“A Manual of Bacteriology, Medical and Applied.” 9th edition. By R. T. Hewlett and James McIntosh.

Sir Isaac Pitman & Sons, Ltd.—

“Industrial Microscopy.” By Walter Garner.

Mr. S. H. Robinson, F.R.M.S.—

“An Introduction to the Technique of Section-Cutting.” Edited by F. M. Ballantyne.

“Insect Life.” By C. A. Ealand.

“Botanical Diagrams.” By A. Flatters.

Trustees of the British Museum—

“Instructions for Collectors, No. 12. Worms.”

Franckh'sche Verlagshandlung, Stuttgart—

“Mikroskopie für Jedermann.” By G. Stehli.

Mr. J. E. Barnard, F.R.S., F.R.M.S.—

£7 (Seven pounds).

Prof. J. Brontë Gatenby, F.R.M.S.—

£10 (Ten pounds).

Dr. Russell Coombe, M.A., F.R.C.S.—

The late Dr. Robert Ceely's Powell and Lealand Monocular Microscope, 1850, with accessories, in case.

Dr. Tierney, describing the latter donation, observed that the instrument was one which the Society was especially glad to have in its Collection, because it exhibits one of the very earliest examples of Powell's introduction of the lever fine adjustment at the top of the limb. The instrument also has historical associations, as is evidenced by the following inscription which is engraved on the stage :—

“As a Record of the voluntary and unwearied personal exertions to mitigate the sufferings of the sick and dying, the true philanthropy and self-denial

and the eminent medical skill manifested by Robert Ceely, Esq. Surgeon of Aylesbury, during the awfully fatal visitation of Cholera, at Gibraltar in the Parish of Cuddington, in the month of August, 1849, by which the extension of the Pestilence, to the neighbouring villages, appears under divine providence mainly to have been stayed, this humble and very inadequate offering is gratefully presented to him by the Revd. John Harrison, Vicar of Dinton, in the County of Bucks."

Dr. Robert Ceely was equally distinguished for his work on smallpox and vaccination, and it was the publication of his monograph, *Observations on the Variolæ Vaccinæ*, communicated to the Provincial Medical and Surgical Association in 1839, and published in the Transactions of that body in the following year, which paved the way for the subsequent passing of the Vaccination Act in 1840.

Signing the Roll.—The following gentlemen present, having subscribed their signatures to the Roll of Fellowship, were received by the President, and duly admitted as Fellows of the Society :—

R. J. Bracey.
W. H. North.
R. Madhava Row.
P. K. Sartory.

Papers.—The following communications were read and discussed :—

Mr. J. Manby, F.R.P.S.—

"Celluloid Impressions of the Surface Structure of Animal Fibres."

Mr. F. W. Mills, F.L.S., F.R.M.S.—

"Some Diatoms from Warri, South Nigeria."

Mr. J. E. Barnard, F.R.S., F.R.M.S.—

"Ultra-Violet Microscopy." Part I. Introduction.

Votes of thanks were accorded to the authors of the foregoing communications.

The following **Papers** were read in title :—

Prof. J. Brontë Gatenby, D.Phil., D.Sc., F.R.M.S., and Dr. E. S. Duthie, M.B., M.Sc.—

"On the Behaviour of Small Pieces of the Pulmonary Cavity Wall of *Helix aspersa*, Kept in Blood."

Dr. J. C. Mottram, F.R.M.S.—

"The Life-History of the Nucleus and Nucleolus, and the Effects of β Radiation upon It."

Miss Kathleen Perry, B.Sc.—

"Mitosis in *Galanthus nivalis*."

Dr. H. Ray, M.Sc., Ph.D.—

"On the Morphology of *Balanitidium sushilii* n.sp., from *Rana tigrina* Daud."

Exhibits.—Mr. Mills exhibited specimens of new species of diatoms illustrating his paper.

Mr. Barnard exhibited instruments and apparatus illustrating his communication.

Mr. Scourfield exhibited a living specimen of *Bathynella chappuisi*, a rare Crustacean belonging to the Order Synedrida.

Announcement.—The Secretary announced that the Biological Section would meet on Wednesday, December 7th, 1932.

The Proceedings then terminated.

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